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"Ribbon" or "Band" Lightning.

By WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

IN examining the literature connected with the records of peculiar or abnormal lightning flashes one meets with a type of discharge which has often been photographed and termed "ribbon," "band," or "tape" lightning. This name is given to it because it resembles on the photograph a piece of ribbon slightly twisted. On closely examining such a specimen, the broad band is found broken up into a series of several long, narrow lines of different intensity and breadth, some of which have occasionally a fluffy or streaky edge, but they are all parallel to each other following similar sinuosities.

Flashes answering to this type have been recorded on photographic plates both when the instrument was in motion and at rest.

In the case of a moving camera, I have previously pointed out in this journal (Vol. IV., 1907; October and November, pp. 217 and 241) several instances where the flashes appeared somewhat ribbon-shaped owing to their being of a "multiple" nature, and sufficiently bright to trail on the plate.

When the instrument is at rest, and under these conditions a "ribbon" type of flash has been secured, another explanation of this peculiar appearance becomes necessary. In the present article it is proposed to deal with these alone, and to bring together so far as possible many of the instances when such flashes have been recorded.

The difficulty that one meets with at the very beginning is that of determining whether the camera used was really at rest or not. Photographers seem to have various notions as to when a camera is stationary or fixed. Thus, we find that one operator is content when the instrument is rigidly held in the hand, while others are satisfied when the camera is tightly pressed against a door-post or railing. When it be remembered that a very slight movement is sufficient to render on the plate a flash of the "ribbon" type, the question of the rigidity of the camera becomes very important in such an inquiry. In discussing, therefore, photographs of this "ribbon" type, which have been taken when the camera was *stated* to be stationary, the first point to determine was whether this was really the case or not. If the method of support is described one can to a certain extent infer whether motion was possible or not. Failing this, one must examine the photograph and see if a portion of the landscape is shown, for from this any motion of the camera during exposure can be sometimes very easily detected. It should be remembered, however, that such objects as branches of trees or any other flexible articles which are subject to movement by the wind should not be considered as the best criteria to rely upon, but they may be useful in some cases. In those instances where information is lacking with regard to how the camera was placed and where no terrestrial objects appear in the field of view, it is best to treat the "ribbon" flash as due to motion of the camera, and therefore excluded from the type here considered.

Perhaps the accompanying illustrations will help to make the above statements a little more clear. Fig. 1 is from a photograph taken by Mr. F. G. Curtis, on

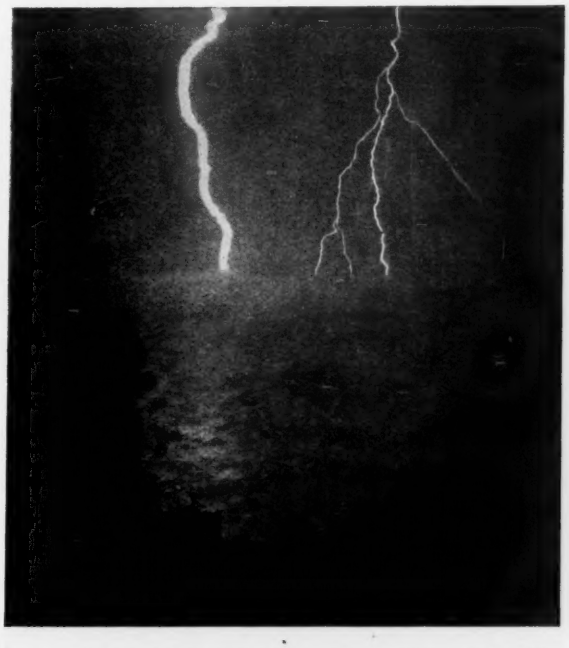

Fig. 1.—Flashes photographed with a camera that was horizontally moving, showing ribbon-like appearance of a multiple discharge. Photograph by F. G. Curtis on May 25, 1907, 9 p.m., at Folkestone.

May 25, 1907, from the "Leas," Folkestone. We see in the foreground the top of the cliffs, and the image of the end of the pier. On the horizon are two lightning flashes, that on the right being an ordinary ramified flash, while the left hand one is, comparatively speaking, very broad, in fact, of the "ribbon" type. These two flashes are independent of each other, although they both occurred during the exposure of this plate.

Now, at the first glance at this photograph, it appears as if the camera was fixed, but if a closer examination be made it will be observed that the landscape in the

foreground, though fairly sharp, is composed of multiple images, showing that the camera had slightly moved in the horizontal direction during the duration of the flash on the left. The flash is therefore broadened out in the same direction as the camera movement, indicating the cause of its "ribbon" nature. The flash was, therefore, of the multiple type. A small vibration of the camera on its tripod due to wind, is quite sufficient to account for the origin of the appearance above described.

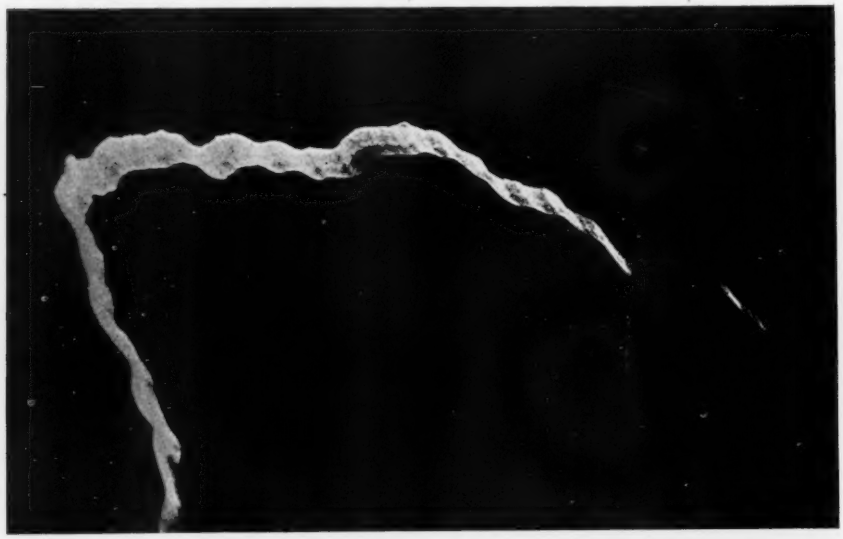

Fig. 2.—Flash photographed with a camera held in the hand, showing ribbon nature due to movement. Photograph by James Leadbeater.

As it is always best to obtain independent evidence if possible, when such a deduction has been made. I communicated with Mr. Curtis, who I may incidentally remark, has secured several very fine records of lightning flashes, to enquire whether it was possible for the camera to have been disturbed in any way during the exposure. That it was most probable that the flash was a multiple one, and rendered broad by the camera movement, will, I think be gathered from the following extract from his courteous reply :—

> "I took 16 exposures, markings only on six plates, two of which are the ones sent you. I stood the camera on the ground quite close to the edge of the cliff in nearly every case. The night was very windy, and it came on to rain in torrents before I had quite finished. The movement was possibly caused by my hand pressing on the camera to steady it from the wind—or from the large flash making me jump a little."

In Fig. 2, we have a case of a flash of lightning photographed by Mr. James Leadbeater, and which was called "ribbon" lightning. With no image of any other object on the plate it would be difficult to say whether this was a true case of "ribbon" lightning, or whether the ribbon form was caused by motion of the camera. As the instrument was held in the hand, and, therefore, a movement most probable, we have here no doubt the trail of a multiple flash. This discharge, it may be noticed, has a particularly pronounced ribbon-like appearance.

The above two examples show how easy it is to produce the appearance of a "ribbon" type of flash, and it is, therefore, not difficult to understand why doubt is so often expressed as to the want of rigidity of the camera support when such results are obtained.

We have, nevertheless, one case, if not two cases, where images of the "ribbon" type of flash were recorded on the photographic plate while the cameras were at rest; but at first there was, in my opinion, a certain amount of doubt about the second photograph. The first of these was secured by Professor H. Kayser, in Berlin, at 10 o'clock on the night of July 16, 1884, and is described in detail in the *Sitz. d. Kön. Preuss. Ak. der Wiss, zu Berlin* (Vol. XLVIII., p. 1119, 1884); no actual statement is made, however, as to how the camera was supported.

Fig. 3 gives a reproduction of the photograph he obtained, while Fig. 4 shows an enlarged portion of the

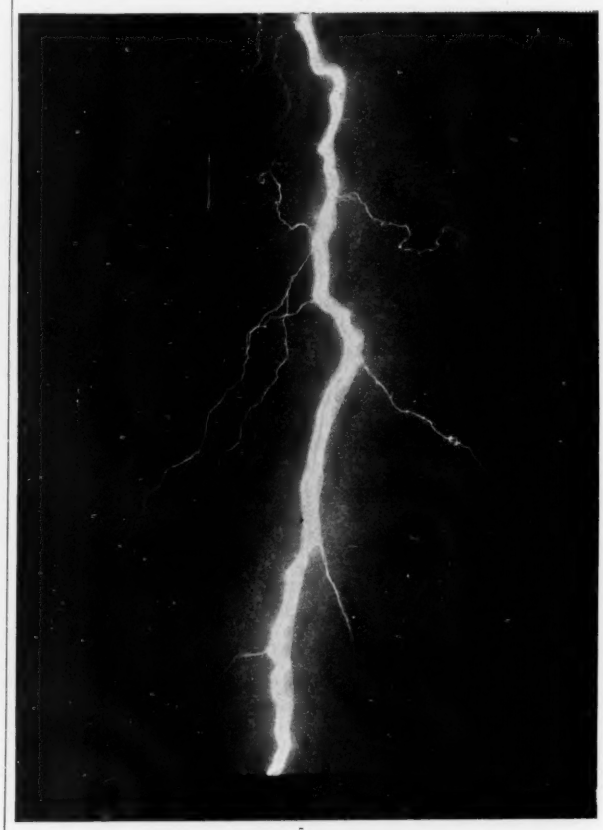

Fig. 3.—Actual "ribbon" flash, photographed with fixed camera, by Professor Kayser, on July 16, 1884. Note the sharpness of the chimneys.

middle part. I should like to take this opportunity to thank Professor Kayser for sending me prints from his original negatives. The attention of the reader is first called to the fact that in Fig. 3 the images of the outlines of the buildings and more particularly the flag-post on the left of the large flash, are single, and present no appearance of duplication. If the breadth of the flash had been due to camera movement, then double images of the chimneys, etc., ought to be visible and separated on the photograph by a distance equal to the width of the flash. As no such multiple images occur, this proves that the camera was at rest.

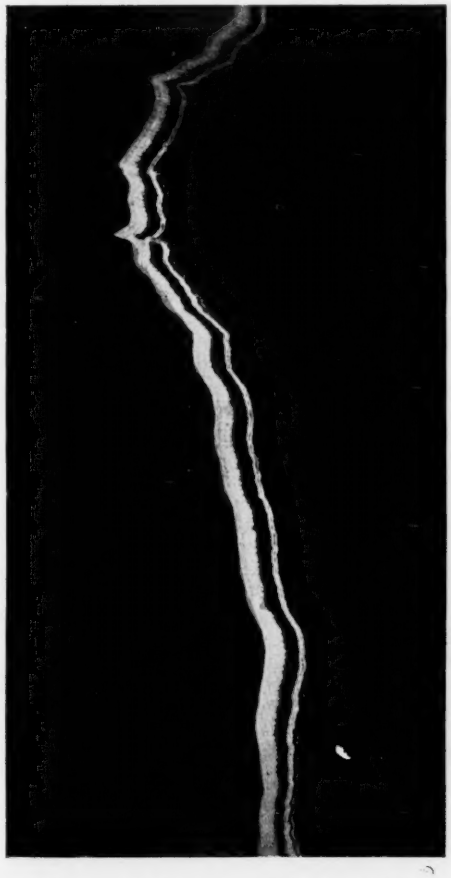

Fig. 4.—Middle portion of Figure 3 enlarged, but right and left reversed

Looking closely at the enlargement in Fig. 4, we see that the whole flash was composed of a series of discharges, and that several of the components are distinctly separated from each other. A close examination of the original print shows that all the ramifications, so far as can be traced, spring from the flash lying most to the left in Fig. 4, suggesting from this fact alone that this flash was the first of the series to occur. I have previously pointed out in this journal (Vol. IV., 1907; November, p. 241) that in cases of multiple flashes the ramifications are as a rule much fainter or non-existent in the after discharges. The last point to be mentioned is the streaky nature in a horizontal direction of one of the middle discharges.

(*To be continued.*)

The Forebears of the Elephant.

By R. LYDEKKER.

THE issue of "A Guide to the Elephants (Recent and Fossil) exhibited in the department of Geology and Palæontology in the British Museum (Natural History)," of which we have been favoured with a copy, affords an opportunity of referring once more to the wonderful evolutionary history of the proboscidean or elephant group—a group in regard to whose early past history we were absolutely in the dark till a few years ago. We say once more advisedly, because in the first number of "KNOWLEDGE & SCIENTIFIC NEWS" the subject was discussed in an admirably lucid manner by Dr. Smith Woodward. Since that date our knowledge has, however, been considerably amplified, so far as minor details are concerned; while it has been found possible to construct provisional restorations of the bodily form of some of the early forerunners of the modern elephants. There is accordingly abundant room for a second article.

Before going further, it will be well to state that the Museum Guidebook has been written by Dr. C. W. Andrews, to whom science is indebted for opening the sealed book of the past history of the elephants, which is now as well known and as nearly complete as that of the horses.

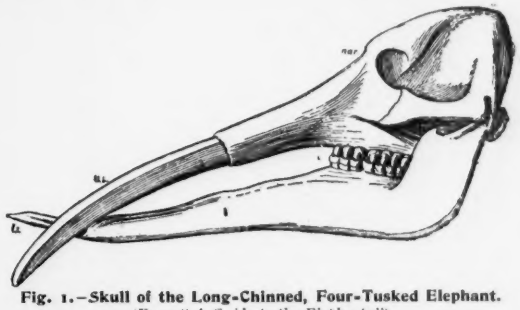

Fig. 1.—Skull of the Long-Chinned, Four-Tusked Elephant.
(From "A Guide to the Elephants.")

Till the recent discoveries in the Fayum district of Egypt, the earliest known representative of the elephant group was the long-chinned, four-tusked elephant, or mastodon, from the middle, or miocene, tertiary strata of Central France, of which the skull is shown in fig. 1. Of this species, which reached the stature of a rather small elephant, it has been found practicable to mount, with a certain amount of restoration, an entire skeleton in the Museum at Paris. Unfortunately, when first mounted, and as figured in Professor A. Gaudry's "Les Enchainements du Monde Animal," the tusks of the upper jaw were made to curve upwards, instead of downwards, thus obliterating at a single stroke a feature tending to connect modern elephants with more ordinary quadrupeds.

It is also not a little remarkable that till Dr. Andrews turned his attention to the subject no one seems to have given a thought as to the meaning of the extraordinarily long chin, terminating in a pair of upturned, chisel-like tusks, which forms the most striking feature in this extraordinary proboscidean. Many naturalists (including myself) described the lower jaw of this and allied species; but, having done this, seemed to think that their task was finished, and furnished not a word of suggestion as to the departure from the modern elephant type this long chin entailed in its owner. So far as is known, the European long-chinned elephant had two pairs of tusks in both sexes; but in an allied Indian species (scien-

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tifically known as *Tetrabelodon pandionis*), the lower pair was absent in some individuals, which, from the analogy of the modern Indian elephant, may be presumed to have been females. Possibly, indeed, the Indian elephant may be the direct descendant of the Indian long-chinned species, while the African elephant, which has tusks in both sexes, may have come straight from its European long-chinned cousin. The chin in the latter projected far beyond the extremity of the upper jaw, and when invested with flesh it seems certain that it must have been opposed by a long, stiff snout, to which it offered a firm support. As shown in fig. 2 the end of the snout, formed by the combined upper lip and nose, was, however, probably free and endowed with a certain degree of mobility, so that it may have been employed to some extent for grasping objects. Compared with its predecessors, the long-chinned elephant was not only a larger but, strange to say, a shorter-necked animal, and it was, therefore, necessary that the muzzle should be elongated in this remarkable manner. The lower tusks not improbably served for digging up roots or tubers, in the same way as the Sudan race of the modern African elephant uses its upper tusks for this purpose.

Fig. 2.—Restoration of the Long-Chinned Elephant.
(From "A Guide to the Elephants.")

The whole arrangement seems, however, as Dr. Andrews remarks, a somewhat clumsy kind of makeshift —in fact, a kind of jerry-building in elephant architecture; and it was not long before it had to give place to a better and more lasting design. In other words the long-chinned type appears to have proved a complete failure—an experiment which turned out unsuccessfully.

The first to put matters in this respect on a more satisfactory and business-like footing seems to have been the species from the upper, or pliocene, tertiary strata of Europe, scientifically known as *Tetrabelodon longirostris*. For this animal it is not easy to suggest a good popular name, "medium-chinned elephant" being, if possible, rather more clumsy and uninviting than the technical designation. On the other hand, Kaup's elephant, or Kaup's mastodon, in allusion to its describer, would be an excellent title. By whatever name known, this species resembled in general characters the long-chinned elephant, but the chin has become considerably shortened, so as scarcely to project in advance of the upper jaw, while the lower tusks, instead of being close together and projecting straight forwards so as to still further prolong the chin, are slightly divergent and somewhat bent downwards at the tips.

In this elephant, as the author of the guidebook observes, it is clear that the lower jaw could not reach the ground when the creature was in a standing posture; consequently, the fleshy upper lip and nose, now freed from their bony support for a considerable portion of their length, must in all probability have become to a certain degree flexible and pendent, and thus better adapted for grasping food and conveying it to the mouth. Dr. Andrews, indeed, compares this species to a modern elephant provided with a longer chin than ordinary, and bearing a pair of small downwardly-directed tusks.

Here arises a very curious question. Modern elephants, as we all know, drink by sucking up liquid into the trunk, from which it is in turn poured into the mouth. There must, however, have been a time when the ancestral elephants imbibed liquid by drawing it directly into the mouth; and it seems practically certain that the long-chinned miocene species drank in this manner, as the flexible portion of the snout was not sufficiently long to have held water and conveyed it to the mouth. Whether, however, the shorter-chinned lower pliocene species had acquired the modern elephant style of drinking is very difficult to decide. Personally, I am rather inclined to consider that it could not have done so, and that the new-fashioned style of drinking did not come in until the chin had acquired the modern fashionable abbreviation. If that be so, *longirostris* must apparently have had to wade into the water whenever he felt inclined for a drink.

Of course, this would be a disadvantage, as an animal so constructed could only slake its thirst in water of considerable depth; and we have, therefore, if my view be the true one, good and sufficient reason why progressive development should continue in the direction of chin-shortening.

Here it must be mentioned that in both the species of primitive elephant referred to above the molar or cheek teeth are of a far simpler type than the enormous and complex grinders of modern elephants. In the long-chinned species the middle teeth of the series were in fact not very unlike those of a pig, having distinct roots and low crowns surmounted by three pairs of transverse ridges. Moreover, the mode of succession was in the main similar to that which obtains in ordinary herbivorous mammals, except that the date of the appearance of the two last pairs was somewhat retarded, so that the last did not come into use till several of the anterior teeth had become worn down and shed. Still, during the earlier years of the creature's life there were generally three pairs of molar teeth in each jaw at the same time. Further, the front molars were succeeded from below or above (according to the jaw to which they belonged) by vertically replacing teeth as in ordinary mammals, although these successional teeth were of much less importance than in the latter, in which they constitute a portion of the permanent series. They were in fact already on the wane.

From the structure of their cheek-teeth these primitive elephants are termed mastodons; and a moment's reflection will suffice to show that these animals could not have lived to anything like the age attained by the modern Indian species, unless, indeed, there were prehistoric dentists capable of constructing "bar-work" of the most massive and powerful kind! In place of living for something like a century and a half, the long-chinned elephant could not, I imagine, have had a longer spell of life than about fifty years.

The lower pliocene *longirostris* made a slight advance on its long-chinned ancestor in that the middle teeth of the cheek series developed four in place of three transverse ridges. The next important point to notice is that, while they still retained the simple type—either 3-ridged or

4-ridged—of molar structure, the early elephants, or mastodons, of the upper pliocene and pleistocene underwent a further development, which appears to have brought them into line with their modern descendants as regards the form and structure of their chins and trunks. The ordinary North American mastodon—a 3-ridged species—is a well-known representative of the short-chinned type, in which minute lower tusks are retained during early life, although these disappear with the attainment of mature age. In other short-chinned mastodons, as represented by a species occurring in the Suffolk crag and a second from India, the molar teeth have, however, become 4-ridged, and lower tusks have completely vanished.

We have, in fact, now before us a creature that is in all respects save one essentially an elephant of the modern type, the chin being so shortened that the whole of the snout is unsupported, and consequently hangs straight down from the head, thus forming a most efficient "hand" and suction-pipe. Possibly—nay, probably—it is owing to the development of this "hand," in the shape of the trunk, that elephants possess so much more intelligence than any other hoofed quadruped. To those who can read aright, the elephant's trunk bears distinct traces of its origin; for on the lower surface is a flattened longitudinal strip bounded by a pair of raised lines, which evidently represent the position of the upper lips.

Elephant-architecture has with this stage attained an effective type of development, which in its main lines seems incapable of further improvement. One weak spot remained, however, in the short-chinned mastodons; this weak spot being the teeth. Not that the weakness displayed itself throughout life. On the contrary, a subadult or mature mastodon would appear to have been a practically perfect animal; but its individual units lacked staying power—that is to say, their duration of life was comparatively short.

As their reproduction is very slow, shortness of life would obviously be a very great disadvantage to elephants, if, indeed, it did not prove absolutely fatal to the survival of the species. Consequently we find increased longevity to be the goal in the final stages in the evolution of the group. This goal was approached by means of an improvement in tooth-structure, whereby the size and consequent resisting power of the molars were vastly augmented, thus rendering the potentiality of life proportionately greater.

To discuss this advance in the size and structure of the teeth in detail would, however, occupy much space, and a very short sketch must accordingly suffice. We have seen how in the molars of the primitive elephants, or mastodons, the number of ridges in the intermediate teeth of the series was increased from three to four, and in one Indian species the number was often raised to five. In what are called the stegodont elephants of India a still further increase in the number of tooth-ridges took place; this increase being most marked in the later teeth, so that the number of ridges in the intermediate teeth no longer remained equal. An increase in the height of the ridges is also noticeable; while a most important factor is the appearance of an additional substance—the cement—in the valleys between the different ridges. To make a long story short, the number and height of the ridges continued to increase, their width began to diminish, while at the same time the amount of cement in the narrowing and deepening valleys underwent an enormous augmentation; till the final result was the production of the type of molar characteristic of the Indian elephant, in which the original ridges take the form of a number of tall parallel transverse plates welded into a solid mass by the cement filling the narrow clefts between them.

This increase in the size and complexity of the individual teeth—more especially in the case of the last pair in each jaw—is accompanied by a further retardation in the times of appearance of the later members of the series, till it eventually results that only a single pair, or at most portions of two pairs, of molars is simultaneously in use in each jaw. Further, in order to provide room, the molars succeed one another from behind in the arc of a circle in place of in a straight line, while the vertically succeeding teeth, or premolars, are altogether lost. The culmination of tooth-development occurs in the mammoth and the Indian elephant, which ought to be the longest-lived members of the whole group. In captivity the Indian elephant is known to attain the age of a century, while in the wild state it probably lives fifty years longer. No definite information is available with regard to the age of the African species, which ought, however, judging from its tooth-structure, to be a shorter-lived animal.

The long-chinned elephant requires, however, a few moments' consideration from an altogether different point of view. This species appears to have had the widest geographical distribution of any member of the family, of which it may be regarded as the great colonising or emigrant representative. First developed in North Africa, where its remains in the early miocene strata of Mogara and Tunisia, this species ranged right across Europe to the confines of north-western India; having probably reached Italy from Africa by means of a land-bridge by way of Sicily, and thence travelling through Greece into Asia. On the latter continent it appears to have given rise to the stegodont and thence to the modern elephants, as remains of the former are unknown in any other part of the world. If this be true, it follows that elephants of the modern type subsequently migrated into Europe and thence to Africa, while in the other direction they wandered by way of Bering Strait to America. Hence we are led to the remarkable conclusion that while the proboscidean group was originally developed in Africa, the modern African elephant is of Asiatic parentage, and a comparatively recent immigrant into the land of its forefathers. It is, however, only fair to add that this conclusion is not accepted by Dr. Andrews, although it has been endorsed by an American writer.

Next to man and the carnivora, elephants appear to have been the greatest travellers the world has ever produced, for, starting from their North African birthplace, they reached by the Bering Strait route nearly to the extremity of South America, while to the north they penetrated the Arctic circle, and to the south, on their return journey, reached the coast in the neighbourhood of Cape Town.

The survey of elephant-evolution has been commenced in the middle of the series with the long-chinned species; and it now remains to trace the latter back to the earliest representatives of the group, all of which were African.

The immediate ancestors of the long-chinned elephant were the primitive mastodons (*Palæomastodon*), which ranged from about 4 to 6 feet in height according to the species. The skeleton was almost exactly like that of a small elephant, with the exception that the neck was relatively longer, while the limbs were probably less massive. Their longer heads and necks, and, above all, the replacement of the long flexible trunk by a stiff, although terminally mobile snout, distinguished them when alive from small elephants of the modern type; while they differed from the long-chinned elephant not only in stature but by the smaller development of the tusks, snout, and chin.

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From the primitive mastodon one step backwards—albeit a somewhat long one—brings us to the moerithere (fig. 3), a creature of only about three feet in height, which, although unmistakably an ancestral elephant, is yet so near the primitive type of hoofed mammals generally as to bring modern elephants into close touch with the latter.

In addition to certain features in the skull, the moerithere displays proboscidean characters in the enlargement of the second pair of incisor teeth (instead of the canines, as in ordinary mammals) to form tusks, the presence of transverse ridges on the crowns of the cheek-teeth, and the trough-like form of the front of the lower jaw. On the other hand, there were three pairs of incisor teeth (in place of one), and also canines in both jaws, while the molars were 2-ridged instead of 3-ridged, and the trough of the lower jaw was comparatively short. The creature could bring its mouth down to the level of the ground, and fed and drank in the ordinary manner; and was, in fact, neither more nor less than a some-

Fig. 3. Restoration of the Moerithere.
(From "A Guide to the Elephants.")

what abnormal generalised ungulate whose abnormality displayed itself in aforeshadowing of the modern proboscidean type.

Thus closes the wonderful tale of elephant-evolution. If we ask why the moerithere displayed a departure from the normal in the development of its second incisors, instead of its canines, into tusks, the only logical answer is that this was part of a preordained plan, for no theory of selection or survival of the fittest can possibly explain the peculiarity. If it be urged that the apparent failure of the long-chinned type is an argument against a preordained plan of evolution, the answer is that such apparent failure exists only in our own shortsightedness.

It may be added, in conclusion, that this triumphant and complete solution of the problem of elephant-evolution is a matter of such extreme and overwhelming importance that it outweighs practically the whole of the rest of the zoological work on mammals of the last dozen years. The discovery of the okapi is not "in it" in comparison; and if the choice lay between losing sight of all other work and retaining only the knowledge of the elephant-pedigree, the answer would be, Hold on to the latter at all hazards and at any price.

Artificial Silk.

By C. AINSWORTH MITCHELL, B.A. (Oxon), F.I.C.

THE manufacture of the products known as "artificial silk" affords a striking instance of a successful superficial imitation of a natural substance.

The idea of producing by mechanical means fine fibres which would possess the lustre and other characteristics of silk and be strong enough to be woven into fabrics is by no means new, although it is only within the last twenty years or so that any degree of commercial success has rewarded the attempts made in this direction.

As far back as 1734 it was suggested by the French naturalist Réaumur that since silk was to be regarded as a naturally hardened "gum" it might be possible to produce similar lustrous fibres by forcing some varnish, such as that used by the Chinese, through minute openings, and drying the filaments thus obtained. But this idea was not followed up, and it was not until after the lapse of 120 years that any practical attempts to produce such artificial fibres appear to have been made.

In 1855 a patent was taken out in this country by Audemars for the manufacture of fine threads from cellulose. The fibres from the bark of mulberry trees were converted into an inflammable compound and dissolved in a mixture of alcohol and ether (collodion), as in the early "wet plate" process in photography, and the solution mixed with a solution of indiarubber. A steel point was dipped in the viscous solution and the threads adhering to it when removed were drawn out as finely as possible by means of a winding machine and left to dry.

This invention may be regarded as the parent of many of the successful processes of the present day, most of which are based upon dissolving cellulose or its compounds in some suitable solvent, and passing the solution through fine openings so as to form filaments which remain in a flexible form on removal of the solvent by evaporation or otherwise. The problem which has been more or less satisfactorily solved in these processes is, in the main, a mechanical rather than a chemical one, for it is not owing to any difference in chemical composition but to a difference in physical structure that silk possesses a lustre which ordinary cotton lacks.

There are, in fact, numerous vegetable fibres which resemble cotton in chemical composition, but have a silken lustre, owing to their possessing a surface like that of silk. Thus the seed hairs of the plant *Eriodendron anfractuosum* closely resemble silk in appearance, and certain varieties of cotton have fibres of such a form that they are much more lustrous than the more common kinds. This difference is so pronounced that long before the invention of artificial silk such cotton was sometimes used as a silk substitute, its natural lustre being increased by singeing off the fine hairs upon the surface and by rolling.

Simple treatment with certain chemical agents is also sufficient to alter the surface of certain non-lustrous fibres in such a way that they reflect the light, or, in other words, become lustrous. A familiar example of this is seen in the mercerisation of cotton ("KNOWLEDGE & SCIENTIFIC NEWS," 1907, p. 271), in which under the combined influence of caustic alkali and of tension the characteristic flattened twisted fibres become straightened into more or less cylindrical tubes having a high degree of lustre. In like manner a silken lustre may be imparted to jute fibre by immersing it for a short time in a strong solution of caustic soda, and then washing it with water.

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But in such cases as these there is only an alteration in existing fibres, which still remain much coarser than those of natural silk, whereas in the artificial products the fibres are constructed from the beginning, and in some of the best preparations are but slightly thicker than those of genuine silk.

This stage of excellence has taken long to reach, mainly owing to the mechanical difficulties of producing fibres of such fineness. After the publication of Audemars' patent nothing further was heard of the production of an "artificial silk" until 1883, in which year Mr. J. W. Swan patented a method of obtaining threads from a solution of nitro-cellulose in acetic acid or other solvent, forced through small openings and subsequently rendered non-explosive by treatment with ammonium sulphide or other deoxidising agent. These fibres were intended primarily for use in the manufacture of mantles for incandescent gas-burners, but are described in the patent as "artificial silk," and were used experimentally in the weaving of extiles.

Two years later Count Chardonnet took out his first patent, the chemical principle of which was similar to that of Swan's patent, and this may be regarded as the beginning of the industry.

In Chardonnet's process cotton or wood-pulp is converted into nitro-cellulose, which is dissolved under pressure in a mixture of alcohol and ether so as to yield a viscous solution. This is conducted through pipes into a series of troughs in the spinning room, each trough ending in a small glass jet $\frac{1}{100}$ millimètre in diameter. The filaments forced through these "silk-worms," as they are termed, were formerly delivered under water, but better results are now attained by a process of dry spinning, in which the solvent is made to evaporate. Four, six, or more filaments are spun together, and the threads passed through ammonium sulphide solution to denitrate them, with the result that they are rendered non-explosive and even less inflammable than ordinary spun cotton. Finally the silk is dyed to any colour required.

The methods of du Vivier (1889) and of Lehner (1889) are very similar to the Chardonnet process. In the former the nitro-cellulose is dissolved in glacial acetic acid and the solution mixed with solutions of gutta-percha in carbon bisulphide and of fish-glue in acetic acid, before being passed through the minute orifices; while in the latter the nitro-cellulose solution is incorporated with a solution of silk waste, and the fine filaments precipitated by means of water.

Cellulose rendered soluble by other means than nitration has also been employed in the manufacture of artificial silk or "lustra-cellulose," as it has been more appropriately termed by Messrs. Cross and Bevan. Thus in some of the methods a solution of cellulose in an ammoniacal solution of copper oxide is employed; in others the cellulose is dissolved in zinc chloride solution; and in others, again, a solution of the compound of carbon bisulphide with alkali-cellulose, termed "viscose" by its discoverers, Messrs. Cross and Bevan, is used. But the principle underlying them all is the same, viz., the formation of fine filaments of the viscous cellulose solution and subsequent separation of the solvent.

The "Vanduara silk," patented in 1894 by Mr. A. Millar, of Glasgow, is the first example of another class of artificial silk, and as regards its chemical composition approximates more closely than the lustra-celluloses to the natural product. It is prepared by forcing a concentrated solution of gelatin through small openings on to a rapidly-moving endless band, which draws the threads out into fine filaments. These are twisted together and exposed to an atmosphere of formaldehyde vapour, which speedily renders them insoluble in water, and leaves them lustrous and supple. The threads spun from the filaments may be dyed readily any desired colour, and are absolutely non-inflammable, but they have the drawback of being greatly inferior to silk in strength, and this defect becomes much more pronounced when they are moistened with water.

According to the results of comparative determinations made by Silbermann, the relative strengths of genuine silk compared with Chardonnet "silk" and Vivier "silk" are 38, 17, and 9.

When moistened with water the strength of true silk is but little if at all affected, whereas the strength of the lustra-celluloses is reduced to about one-eighth, although on drying they regain their original strength. This drawback of deficient strength is shared by all the artificial silks, though the lustra-celluloses are superior in this respect to gelatin "silk," and all are quite as strong if not stronger than genuine silk that has been "weighted" by the addition of metallic compounds, as is now frequently done.

Although quite as lustrous as silk, some of the artificial products have a scintillating appearance which the genuine substance lacks, and all feel harsher to the touch.

With the exception of gelatin "silks," which do not seem to have been extensively employed, artificial silks are readily distinguishable from silk or wool by the fact that they burn without emitting the characteristic smell of burning animal nitrogenous matter.

They may also be distinguished by their appearance under the microscope, especially in transverse section, in which they usually appear as irregular angular shapes, generally considerably larger than the regular pointed ovals of the transverse sections of ordinary silk.

Various chemical agents may also be employed for their detection and differentiation. Thus a solution of copper oxide in ammonia dissolves both the natural and artificial silks, but on the addition of water the cellulose composing the latter is reprecipitated, whereas no precipitate is obtained from the solution of silk. Again, the Chardonnet silk may be differentiated from the viscose silks by the fact that in the case of the former faint traces of nitro-cellulose remain, however carefully the denitration is carried out, and these may be detected by giving a bright blue coloration when the "silk" is treated with a solution of diphenylamine in strong sulphuric acid.

Their deficiency in strength has prevented artificial silks being used more extensively for clothing, but they are largely employed in the manufacture of ribbons, and for tapestries, upholstery, and other decorative work in which strength is not a primary consideration, and owing to their relatively low price and beautiful lustre are well suited for such purposes.

MESSRS. GEORGE PHILIP AND SON, of 32, Fleet Street, have just published their new list of optical lantern slides specially prepared for educational purposes. The careful and intelligent arrangement of their geographical slides has been arrived at under the direction of the Curators of the Educational Museum belonging to the Teachers' Guild, and the order is as follows:—(1) Maps—Physical, Political, Ethnographical; (2) Mountains; (3) Lakes; (4) Rivers and Valleys; (5) Caves; (6) Coast Scenery; (7) Towns and their Positions; (8) Types of Men and Customs.

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Eye Spots on Butterflies' Wings.

By PERCY COLLINS.

WITH the exception of birds and flowers, no forms of life exhibit a wider range of colour than do butterflies and moths, while the varied designs with which Nature has beautified the wings of these insects have, time and again, formed subject for discussion and admiration. There are patterns simple and patterns complicated, patterns mysterious, and patterns the meaning of which students have been able, in measure, to decipher. But of all marking seen on butterflies' wings, none are more curious or more perplexing than the ocellate or eye spot. English observers of insect life will at once associate this mark with our common "peacock" butterfly, as well as with many of the *Satyridæ* or "Browns." Among exotic Lepidoptera, the eye spot is often very large, very beautiful, and very conspicuous, and is particularly common in the families, *Satyridæ*, *Brasolidæ*, and *Morphidæ*. Many moths, too, notably

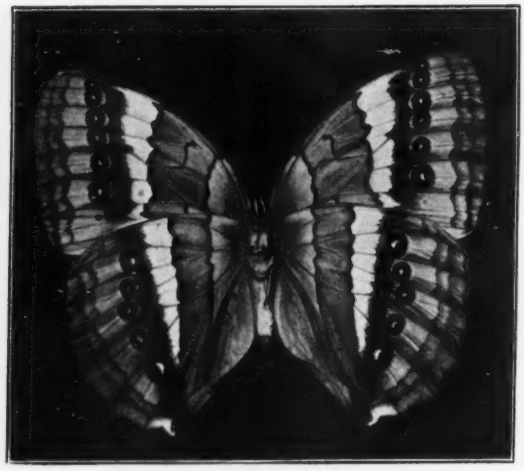

Fig. 1.

the Saturnids, or silk moths, exhibit the same ocellate design, the centre of the spot being often "clear," that is, destitute of scales.

Among butterflies, the most striking examples of the eye spot are invariably found upon the under surface of the wings. At Fig. 1 is shown the underside of a beautiful Assam butterfly, known as *Sticopthalma camadeva*. No less than 22 repetitions of the "eye" occur on the wings, although not one spot appears upon the upper side. A genus of butterflies, known as Tenaris, confined to the islands of the Eastern Hemisphere, of which a species (*T. catops, ex* New Guinea) is shown at Fig. 2, is remarkable for having several large eye spots on the underside of each wing. The upper surface of the wings is usually white, broadly banded with brown, and with some indication of the underlying spots.

The genus *Catagramma* and its allies (Fig. 3a) has somewhat similar eye spots on the underside of the hind wings, while some of the species have one single and one double ocellate spot side by side, which together bear some resemblance to the figure "8o," a characteristic from which the genus gets its name. In *Callicore* (Fig. 3b), too, this combination is more or less distinct.

Of the many moths with eye spot markings, two examples must suffice. The South African Saturnid moth, *Gynanisa maja* (Fig. 4), has very distinct, almost startling, eye spots; while in the Brama moth (Fig. 5),

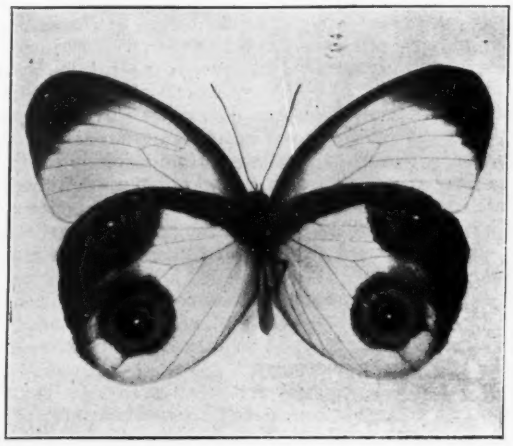

Fig. 2.

from Assam, the markings, though less striking, are the result of a more complicated design.

Students of biology have often asked themselves what may be the meaning of eye spots on butterflies' wings. A satisfactory answer to the question has not yet been discovered, although several theories, of

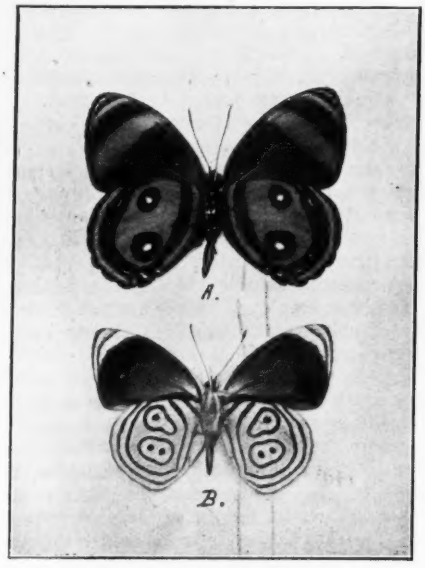

Fig. 3.

a more or less limited application, have been suggested. To regard eye spots as purely ornamental is scarcely permissible in the present state of our knowledge, for the marking is one of the most intricate of all natural designs. Its existence seems to indicate an evolu-

tionary process both lengthy and complicated, and this, in its turn, suggests a utilitarian application of the eye spot to the needs of its possessor. In the case of certain larvæ and beetles which have large, staring eye spots at the anterior end of their bodies, there is reason to suppose that the object in view is the mimicry of real eyes, calculated to invest the organism with a "terrifying appearance," from which definite protective advantages are known to accrue. For several

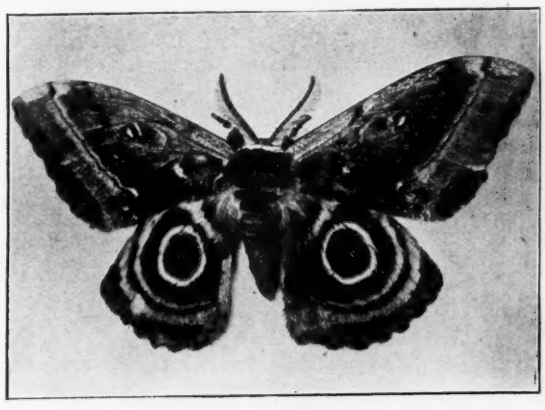

Fig. 4.

reasons, however, this theory is scarcely applicable to butterflies and moths. In the majority of instances, the eye spots on their wings are not exposed prominently to view when the insect is in its resting attitude and (presumably) very much in need of protection. Moreover, the repetition of the mark would seem to detract from its actual eye significance. It has been suggested that eye spots, especially if large and

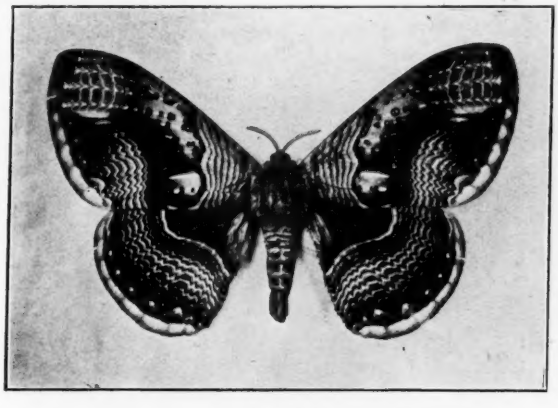

Fig. 5.

conspicuous, would be of value to butterflies and moths when on the wing, as marks likely to attract birds as points at which to strike. Birds may be presumed to recognise from experience that the eye of any creature is a vulnerable point, and in hurried pursuit may make a dash for a spot which has the appearance of an eye. And if a bird, in chase of a butterfly or moth, were merely to pierce one of the eye spots with its beak, the insect would not be seriously disabled, and would gain time to avoid its pursuer while the pursuer was recovering from its surprise at having done so little damage. On the other hand, the fate of an insect is sealed if a bird pierces or mangles any part of its body. It should be added that, though ingenious, this theory is not yet sufficiently proven, although insects are said to have been captured with their eye spots pierced as though from the attack of a bird.

In conclusion, it must be admitted that eye spots on butterflies' wings constitute one of those many mysteries of natural history which have so far evaded the researches of science. The student records his observations, and suggests his theories. But, if you ask him, "What do these eye spots mean?" he must answer frankly: "I do not know."

The Meteoric Season.

WITH July, the really attractive season for meteoric work may be said to commence. In the spring months meteors are rare, but after the middle of July the sky shows unusual activity to the persevering watcher. The great Perseid display begins at about that time, and there are a great number of minor streams which apparently come into play at the same period. Though much has been done in this department, though many facts have been gleaned and some important discoveries effected, yet we only stand as yet on the borderland of a full knowledge of meteors. With the great majority of systems we are very little acquainted, and of the great showers of April, August, and November we are still deficient as to many facts connected with the details of their visible characters and physical conformations. Observers of meteors have still to rely upon the naked eye method, the photographic means of observation not being found applicable to general meteoric work. It is astonishing, however, how accurate the hurried eye estimates may become after much practice, and in the case of an observer who possesses capacities adapted to this work. Radiant points can often be determined within 1° of probable error, and mistakes in applying meteors to their centres are seldom made by those who consider all the facts which can lead them to correct conclusions.

This year the Perseids will occur in moonlight, but the development of the shower can be well followed at the end of July and early part of August. The change in the place of the radiant forms the most noteworthy feature of the shower, and it is very distinctly visible every year to all observers who have acquired proficiency in this department of work. The places of the radiant should be ascertained for each night, and the centres of contemporary showers, of which there are several scores, should also be found.

W. F. DENNING.

FROM Mr. Goerz, of Holborn Circus, we have received an interesting pamphlet describing his new Goerz "Pagor" Binoculars, in which the latest improvements in prismatic glasses are combined with unusual lightness. The reduction in size of the Pagor glass has been effected at the sacrifice only of such qualities of the lens as make it suitable for night vision, and as few people desire to use binoculars at night the advantages more than counterbalance the omission.

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Some Novel Methods in Spectrum Analysis.

Binocular Spectroscopy.—Part II.

By W. MARSHALL WATTS, D.Sc.

(Continued from page 101.)

For the recognition of well-known flame-spectra, of sodium, lithium, thallium, barium, strontium, calcium, &c., it is not necessary to employ any slit; the different coloured images of a Bunsen flame seen at 8 or 10 feet off being perfectly distinct and characteristic; but a sharper spectrum is obtained by using the device shown in Fig. 5, which represents a Bunsen burner provided with a metal screen having a slit of about one millimetre in width. Fig. 6 shows the flame-spectra of barium, strontium, and calcium as seen with this arrangement when the flame is fed with the chlorates of these metals.

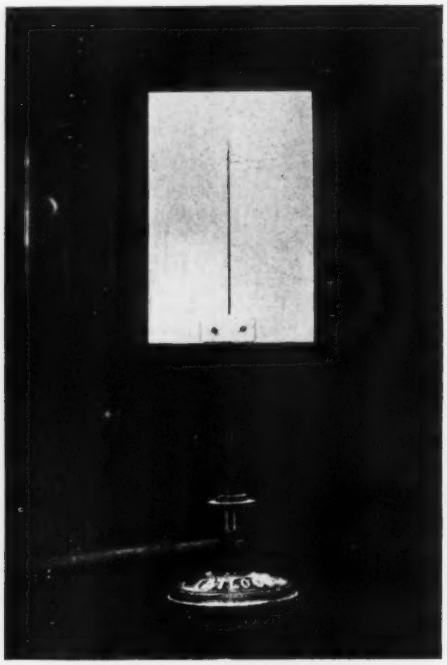

Fig. 5.

In comparing these spectra it may be noticed that there is one line in each due to the metal and not to the oxide or chloride. The line of calcium is at 4226, that of strontium at 4607 (the well-known blue line Srδ), and the corresponding line of barium is at 5536; and these lines have been shown to be related to the atomic weights of the metals producing them, that due to the metal of smallest atomic weight being situated furthest in the blue, and, consequently, due to the most rapid vibrations; and, further, that the differences in rapidity of vibration are proportional to the differences of the squares of the atomic weights. In the barium spectra lines due to the chloride are seen at 5136, 5171, 5205, and 5242; these are not seen if barium nitrate is used instead of the chloride or chlorate. The conspicuous band at 4873.5 is due to the oxide. In the strontium spectrum the bands sharply defined on the red side at

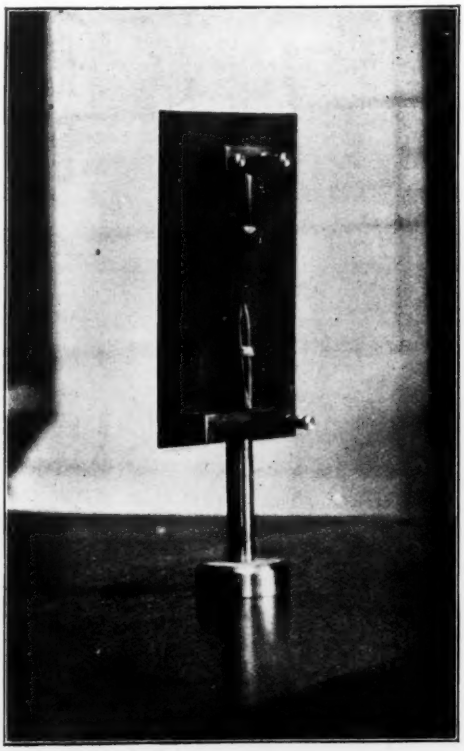

Fig. 7.

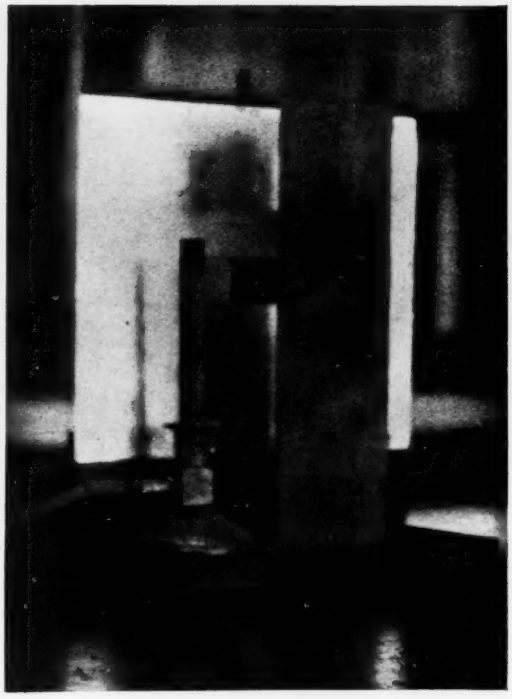

Fig 8.

6351, 6597, and 6731 are due to the chloride. In the calcium spectrum there are chloride lines at 6202, 6183, 6069, 6044, and 5934; the band at 5543 to 5517 is due to the oxide.

Fig. 7 shows a little piece of apparatus useful in observing spark-spectra—a plate of ebonite with a slit and holders for the electrodes mounted on the ebonite plate; but here also for the rapid recognition of spectra no slit is necessary, the spark itself being a sufficiently definite luminous object.

shown in Fig. 9, and the spectrum of a source of light placed behind the slit shown at the left is seen projected upon the scale. The positions of the spectroscope, scale, and slit being properly adjusted, the wavelengths of the lines of the spectrum can be read off directly upon the scale. For greater precision in reading a little sliding piece is provided which carries a vernier and black pointer. This arrangement is best used in a darkened room with an adjustable shaded gas-light for the illumination of the scale.

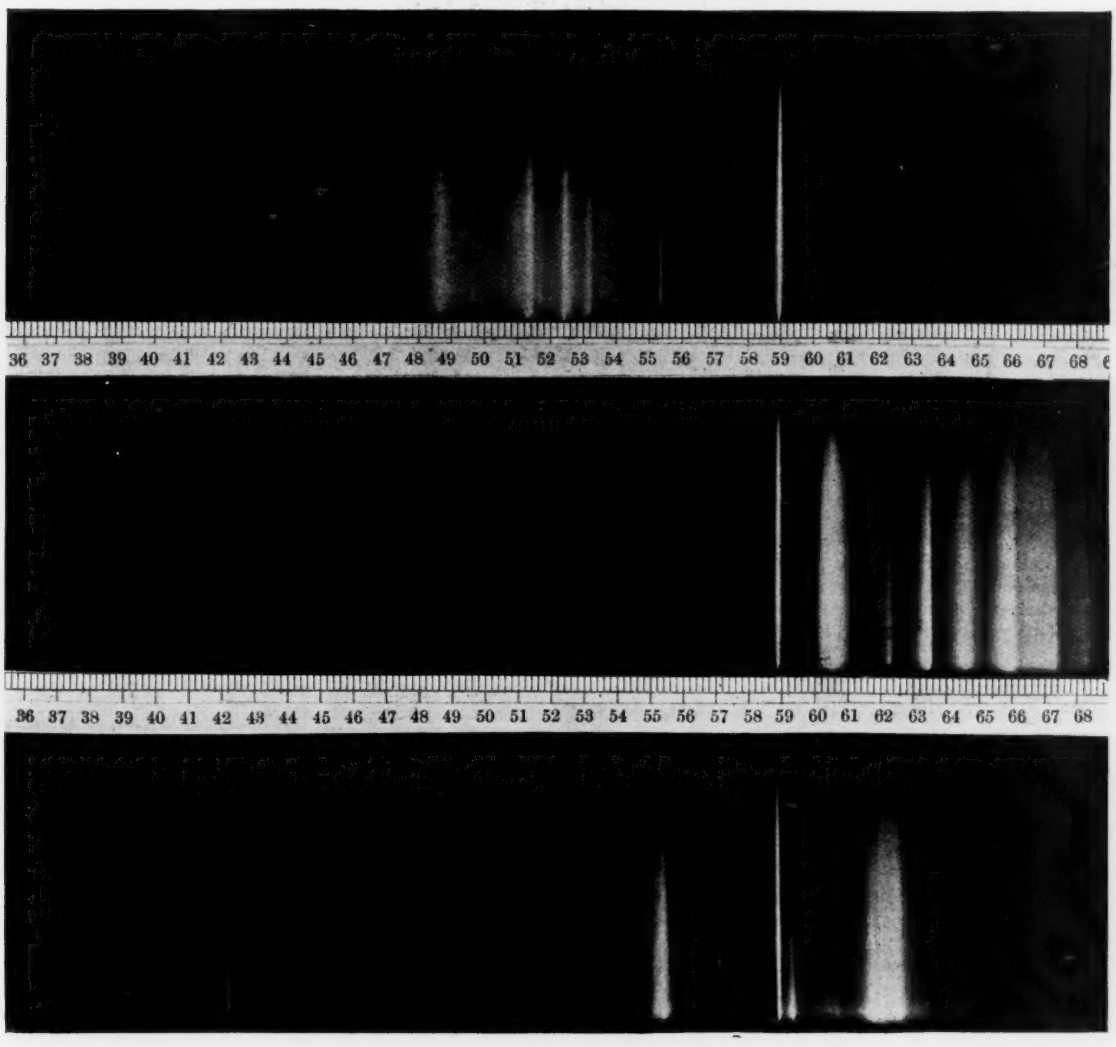

Fig. 6.

In order to compare two spectra the apparatus shown in Fig. 8 is employed. It consists of a metal plate with a slit through which passes the light reflected from both sources by means of mirrors fixed at an angle of 45° with the plate. The apparatus is shown from the back, with a Bunsen burner as one of the sources of light. Another Bunsen is placed at the other side, or a vacuum-tube, or spark-discharger as may be required.

For purposes of measurement a very simple arrangement is found to be efficient. The spectroscope on its stand is pointed directly at a scale of equal parts as

Another arrangement, which may be preferred, is to have the slit-plate divided horizontally; the upper half being fixed, and the lower half carried by a slider; which, carrying a vernier, moves along a fixed scale of 400 mm. in length. The fixed slit is illuminated by the source of light to be examined, but the lower slit is illuminated by the light from a small sodium flame, reflected by a mirror behind the slit, which is carried with the slider; in this way the yellow sodium line is used as a bright pointer in measuring the spectrum.

For the observation of the solar spectrum the best

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arrangement is the old one of a slit in the shutter of a dark room, but a good spectrum may be observed by looking at a silvered glass tube backed with black velvet, and placed in the sun-light. As with the solar spectrum there is plenty of light, it may very well be observed in the second order, in which the sodium lines will be seen widely divided.

for the observation of the chromosphere and prominences. The instrument would also prove a useful companion for the observation of lightning or meteors, or when favoured with a display of aurora. In the case of fireworks it reveals at once the substances which have been employed in the manufacture of the Roman candles, rockets, &c.

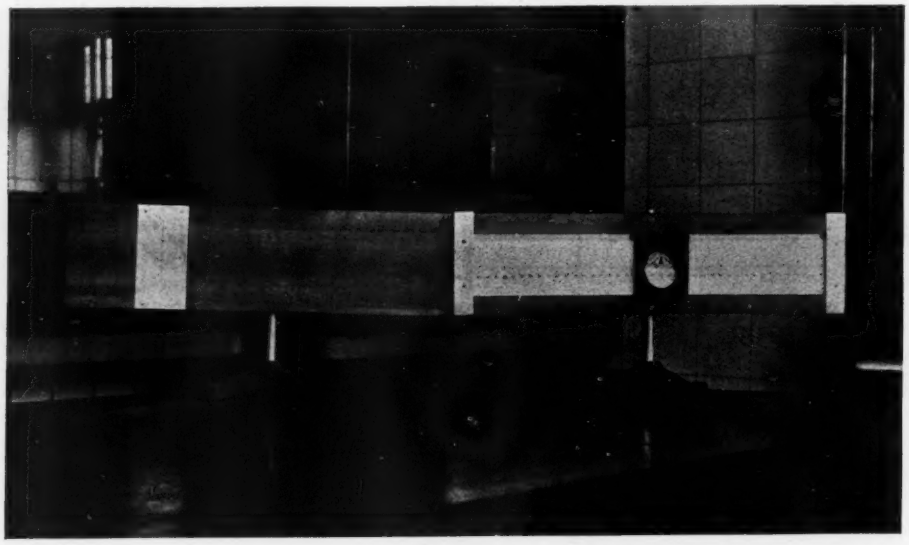

Fig. 9.

Such a field-glass with gratings as we have described would be found very useful on the occasion of a total eclipse of the sun. With a dark-glass it could be used, as an opera-glass, to observe the progress of the eclipse until totality, when it would be ready, as a spectroscope,

For the observation of absorption spectra the simple arrangement of an incandescent gas-burner behind a slit proves effective, but the burner should have a metal chimney (with an opening opposite the slit) to prevent too great illumination of surrounding objects.

The Index Method of Calculating Photographic Exposures.

By G. H. BRYAN, Sc.D., F.R.S.

THE exposure required to take an ordinary photograph such as a landscape, with a hand or stand camera, depends at least on the following four factors :—

(1) The light value.
(2) The stop employed.
(3) The subject.
(4) The speed of the plate.

Of these factors the light value may, of course, be determined by an actinometer, but if calculated independently, it depends essentially on—

(1*a*) The altitude of the sun, which again depends on the time of year, time of day, and latitude of the place;

(1*b*) The state of the atmosphere, whether clear or cloudy.

In order to simplify the multiplications and divisions required in taking account of these factors, various exposure calculators, based on the principle of the slide rule, have been put on the market. Unfortunately, however, a slide rule with a single movable scale cannot perform a multiplication or division sum with more than three factors, and we find that one of the calculators in question only gives the exposure for one particular stop, another only for one particular class of subject, and if the exposures have to be calculated for other stops or subjects it is necessary to count a certain number of divisions to the right or left.

These difficulties may be entirely got over by the use of index numbers, and the final exposure calculated in a very simple way by a single addition sum which may either be performed mentally or jotted down in the exposure note-book.

In the first place it will be observed that when it is found that any particular exposure is a little too short, the photographer usually doubles the exposure; if it is a little too long the exposure is usually halved. For more accurate work, such as bromide enlarging, where errors of exposure cannot be compensated for by a corresponding increase or decrease of density, it is necessary to make smaller changes by increasing the exposure in the proportion of 3 to 2 or 4 to 3, but the difference between the fractions $\frac{3}{2}$ or $\frac{4}{3}$ is not sufficient to make any great difference in the final result, and intermediate intervals are rarely used. It will thus be noticed that doubling and halving are the most important variations commonly made in exposures.

Now, consider the series of index numbers given by the following table :—

TABLE A.

Number ..	1	2	4	8	16	32	64	128	256	512	1024
Index ..	0	1	2	3	4	5	6	7	8	9	10

It will be seen that every time we double a number, we add 1 to its index, and conversely. Thus, if we add 1 to 2, which is the index of 4, we get 3, which is the index of 8. If we multiply a number by 4 we add 2 to its index, if we multiply by 8 we add 3 to its index, and so on; similarly to divide by 2 we subtract 1 from the index, and so on.

The mathematician who understands logarithms is perfectly familiar with all this, and will find nothing new in the idea.

For intermediate indices it will be sufficiently correct to take a number midway between the previous and following numbers; thus, $2\frac{1}{2}$ is midway between 2 and 3, and is the index, roughly speaking, of 6, which is midway between 4 and 8.

If, now, any change in the light value, subject, plate speed, or stop requires the exposure to be multiplied by 2, 4, or 8, that change requires an addition of 1, 2, or 3, as the case may be, to the index number. All these changes can be taken account of in a single addition sum if we draw up tables of index numbers for the effects of sun's altitude, weather, stop, subject, and plate speed.

(2) *Index of the Sun's Altitude.*—The light received from the sun per square foot or square mile of the earth's surface is greatest when the sun is vertically overhead at a place within the tropics at noon. We may take the corresponding index to be 0. When the sun's altitude is 30° the lighting is halved (doubling the exposure), so that the index for 30° is 1, similarly for altitude 45° the index is $\frac{1}{2}$.

The following table gives roughly the values of the sun's altitude index for the several intervals preceding and following noon in this country.

TABLE B.

	Index.	Interval.		Index.	Interval.
January ..	2	11 to 1	July	$\frac{1}{2}$	9 to 3
February ..	$1\frac{1}{2}$	11 ,, 1	August ..	$\frac{1}{2}$	10 ,, 2
March ..	1	10 ,, 2	September .	1	10 ,, 2
April	$\frac{1}{2}$	10 ,, 2	October ..	$1\frac{1}{2}$	11 ,, 1
May	$\frac{1}{2}$	9 ,, 3	November ..	2	11 ,, 1
June	$\frac{1}{2}$	9 ,, 3	December ..	2	11 ,, 1

For times outside these hours the usual rule would appear to be equivalent to the following :—Add $\frac{1}{2}$ for every hour till the index number is about $2\frac{1}{2}$. This index corresponds to an altitude of about 10°, after which the changes of altitude cause rapid variation in the index, and the effects of a variation in latitude or an error in estimating the longitude in order to correct the time would be considerable.

For this altitude the shadow of a stick is about 5.6 times the height of a stick. If it is required to make use of the last gleams of sunshine in photographing an object which cannot be re-visited, or, indeed, to make use of the strong contrasts obtained when the sun is shining low down in the sky, the best way is to measure the length of the shadow of a stick and divide it by the length of the stick. Thus, if a stick 3 feet long gives a shadow 12 feet long, that is, 4 times the length of the stick, we take the index number under 4 as the altitude index of the sun, and this from Table A is 2. If the length is 12 times the length of the stick, then since 12 is midway between 8 and 16, we take the index to be $3\frac{1}{2}$, and so on. This method only answers at low altitudes, for if the shadow were the same length as the stick, the altitude would be 45° and the index would be $\frac{1}{2}$, whereas the index number opposite 1 is 0, and gives an incorrect result.

(3) *Weather Index.*—If we take the brightest sunshine to have 0 as its index, the index numbers for the states described in the Burroughes, Wellcome, and Co. light tables will, except in the extreme cases when the sun is low down in the sky, be as follows :—

TABLE C.

"Bright Sunshine"	0
"Sun Shining Through Light Clouds" ..	$\frac{1}{2}$
"Diffused Light"	1
"Dull"	$1\frac{1}{2}$
"Very Dull"	2

The correction for height above sea-level will be made according to the B.W. Tables by subtracting $\frac{1}{2}$ for 2,500 feet. According to another source the index is $\frac{1}{2}$ for cloudy and 1 for gloomy weather.

(4) *Aperture or Stop Index.*—The proper unit to take in this case is the maximum aperture conceivable. If the lens were close up to the plate (a condition capable of practical interpretation in the case of microscope objectives) the incident light would form a cone of vertical angle 180°. The same is the case in contact printing when a plate in its printing frame is exposed to light from the sky in all directions out in the open. We may take the index number of the aperture in this case to be zero, and the system of index numbers will thus readily enable comparison to be made between exposures in contact printing and enlarging respectively. The list of index numbers for the various apertures will work out as follows :—

TABLE D.

Stop	*f*/4	*f*/6	*f*/8	*f*/11	*f*/16	*f*/22	*f*/45	*f*/64
Index ..	6	7	8	9	10	11	12	13

This list is easy to remember if we notice that 8 is the index of *f*/8, the largest stop used with cheap objectives, and that each succeeding stop of the scale commonly used increases the index by unity.

(5) *Index for Colour Screen.*—For a 2, 4, or 8 times screen the corresponding index numbers will be 1, 2, 3 respectively (Table A).

(6) *Index for Objects in the Shade, Narrow Streets, and Ravines.*—In this case the most rational plan, if the sun is not shining directly upon the objects, is to make a rough estimate of what proportion of the sky is visible from the point at which the objects to be photographed are situated. For example, if a group is under the shadow of a tall building or perpendicular rock, only one-half of the light from the sky will fall on it, and the corresponding index is 1. The table will be as follows :—

TABLE E.

Proportion of sky visible	$\frac{3}{3}$-$\frac{3}{4}$,	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$,	$\frac{1}{6}$	$\frac{1}{8}$
Index	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3

(7) *Index for Interiors.*—Here the opening in the windows takes the place of the stop in the camera, and the light admitted to the room is correspondingly reduced. If the window is not opposite any tall buildings the index can be calculated by measuring the area of the windows in square feet, and the distance of the windows to the opposite wall of the room. In taking indoor portraits the distance should be measured from the sitter to the window. The rule will be as follows :—

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Double the index of the distance from the window and add $2\frac{1}{2}$ or 3 to it, and subtract the index of the area of the windows.

For a skylight receiving light from the sky in all directions the constant to be added would be the index of 3.1416 which is just over $1\frac{1}{2}$. For a window in a wall only half the sky is visible, making the constant $2\frac{1}{2}$ or over. The absorption by the glass of the window would increase the constant, but it would be slightly decreased by the light reflected from the ground. Probably 3 would be safer than $2\frac{1}{2}$, except when a very light foreground outside is exposed to strong glare, or there is snow on the ground, when it might be possible to reduce the constant down to 2.

(8) *Subject Index.*—The subjects which require the shortest exposure are sea and sky, and the natural plan is to take the index of such subjects as zero. We then have the following list :—

TABLE F.

Clouds and sky	0 to 1
Sea	1
Open landscapes, shipping, &c.	2
Landscapes with bright foreground	3
Street scenes, groups, landscapes with strong foreground..	4
Outdoor portraits in shade	6

(9) *Index of Plate Speeds.*—This has to be so chosen that when the various indices are added up their sum which gives the exposure index is 20 when the exposure is 1 second. This is a matter of convenience, but it is a fortunate coincidence that this makes the speed index zero for the fastest plates on the market working with the most efficient focal plane shutters.

The speed index of the various brands of "Special Rapid" plates with an H and D speed of about 200 is $2\frac{1}{2}$ for a full exposure or 2 for a short exposure. The plates of half this speed (H and D 100) would have an index $3\frac{1}{2}$ for a full exposure.

(10) *Exposure Index.*—As just stated, it is convenient to choose the exposure index so that for an exposure of 1 second the index is a multiple of 10, and 20 is the smallest multiple that will answer the purpose. The system of indices of the plate speeds just described is based on this choice, but happens, as we have said, to exactly fit the circumstances of the case. With this convention the complete table of exposure indices will stand as follows :—

TABLE G.

Index ..	—	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$	12	$12\frac{1}{2}$	13	$13\frac{1}{2}$	14	$14\frac{1}{2}$
Exposure	—	$\frac{1}{1000}$	$\frac{1}{750}$	$\frac{1}{500}$	$\frac{1}{350}$	$\frac{1}{250}$	$\frac{1}{180}$	$\frac{1}{128}$	$\frac{1}{90}$	$\frac{1}{64}$	$\frac{1}{45}$
Index ..	—	15	$15\frac{1}{2}$	16	$16\frac{1}{2}$	17	$17\frac{1}{2}$	18	$18\frac{1}{2}$	19	$19\frac{1}{2}$
Exposure	—	$\frac{1}{32}$	$\frac{1}{22}$	$\frac{1}{16}$	$\frac{1}{11}$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{2}{3}$
Index ..	—	20	$20\frac{1}{2}$	21	$21\frac{1}{2}$	22	$22\frac{1}{2}$	23	$23\frac{1}{2}$	24	$24\frac{1}{2}$
Exposure	—	1	$1\frac{1}{2}$	2	3	4	6	8	11	16	22
Index	25	$25\frac{1}{2}$	26	$26\frac{1}{2}$	27	$27\frac{1}{2}$	28	$28\frac{1}{2}$	29	$29\frac{1}{2}$	30
Exposure	32	45	64	90	120	180	250	350	500	750	1000

(11) *To reduce from seconds to minutes*, subtract 6 from the index of the exposure in seconds (6 is easy to remember, being the first figure of 60, the number of seconds in a minute). This is equivalent to dividing by 64, which is quite sufficiently accurate for the purpose of calculating exposures.

(12) *Final Rule.*—The whole process of calculation may now be summed up in the following single rule :—

Add together the index numbers for the day and hour, weather, subject, plate speed, and stop; the final sum gives the exposure index.

In working in interiors the index calculated as explained in Section 7 must also be added, and if a colour screen is used its index must be also added in.

Examples.—In illustration of the Index method we append the following examples :—

Ex. 1.—January, between 2 and 3 p.m., cloudy (diffused light), open landscape with no strong foreground, special rapid plate, stop F/16.

	Table.	Index.
Sun's altitude up to 1 p.m. ..	B	2
Correction for 2 hours		1
Weather	C	1
Subject	F	2
Plate speed		$2\frac{1}{2}$
Stop F/16	D	10
Exposure index		$18\frac{1}{2}$

Required exposure = $\frac{1}{3}$ second.

Ex. 2.—Landscape with strong foreground taken near sunset, tripod 4 feet high, casts a shadow 38 feet long, slight haze in sky, special rapid orthochrome plate with 4 times screen stop F/32.

Here the shadow is more than 9 times the height of the tripod, and will lengthen before the picture is taken, we, therefore, take the next higher altitude index corresponding to a shadow 12 times height.

	Table.	Index.
Sun's altitude	A	$2\frac{1}{2}$
Correction for haze		$\frac{1}{2}$
Subject	F	4
Plate speed		$2\frac{1}{2}$
Colour screen	A	2
Stop F/32		12
Exposure index		$23\frac{1}{2}$

Required exposure = 11 seconds.

Ex. 3.—February, 3 p.m., "very dull," indoor portrait sitter distant 6 feet from a window measuring about 15 square feet in area, facing a building which cuts off about $\frac{1}{3}$ of the sky as seen from the window, ordinary plate half the speed of the "Special Rapid," stop F/22.

		Table.	Index.
Sun's altitude up to 1 p.m. ..		B	$1\frac{1}{2}$
Correction for 2 hours			1
Weather		C	2
Subject portrait, *referred to the open*		F	6
Correction for Interior.	Dist. from window $2\frac{1}{2}$ / Constant $2\frac{1}{2}$ / Area of window 4		
$2\times2\frac{1}{2}\div2\frac{1}{2}-4$ =			$3\frac{1}{2}$
Effect of obstruction, $\frac{2}{3}$ light visible		E	$\frac{1}{2}$
Speed of plate..			$3\frac{1}{2}$
Stop F/22		D	11
Exposure index in seconds			29
Reduction to minutes, subtract			6
Exposure index in minutes			23

Required exposure = 8 minutes.

(13) *Index Tables for Actinometers.*—If an actinometer be used, its time of exposure will be calculated under the conditions, as to weather, under which the photograph is required, and if used in an interior it will give the light value for that interior. There will thus be only a single index in place of those of §§2, 3, 6, and 7. The rule for calculating the index of the light value from the actinometer time will necessarily vary with the actinometer used. With the Imperial actinometer the index of the light value appears to be obtained by subtracting $21\frac{1}{2}$ from the index of the exposure in seconds (Table G) or 15 from the index of the actinometer exposure in minutes if the final exposure is to be calculated in seconds.

(14) *The advantages of the Index method* may be summarised as follows :—

1.—*The calculation of exposures is reduced to a single addition sum.*

2.—Slide rules are dispensed with. As we have seen, these do not suffice to take account of all the data required in determining an exposure.

3.—Any number of factors on which the exposure depends may be taken into account, and the method is thus applicable under the most complex conditions.

4.—Cumbersome fractions are avoided, only halves being used in the index numbers.

5.—When the sun is low down in the sky a change of latitude or longitude would cause a considerable error in the light value if calculated from tables, and in this case an estimate based on the length of the shadow can be substituted which is free from this uncertainty. If it were necessary to use an actinometer the light might go while the paper was blacking up.

6.—There would be no difficulty in graduating a camera with the index numbers of the different stops and exposures, and in this way the calculations would be further simplified.

7.—There is practically no need to take account of the tens in the addition, as there is no fear of mistaking, for example, $13\frac{1}{2}$, or an exposure of $\frac{1}{50}$ for $23\frac{1}{2}$, which gives an exposure of 11 seconds.

8.—The rule for conversion from seconds to minutes is very simple and easy to remember.

9.—It is not difficult to write down the exposures corresponding to the various indices without looking at the table by counting powers of 2 or $\frac{1}{2}$ from the nearest multiple of 20. Thus, for example, if the index is $23\frac{1}{2}$, or $3\frac{1}{2}$ more than 20, we count (1, 2); (2, 4); (3, 8); ($3\frac{1}{2}$, 12); or the exposure is 12. If the index is $17\frac{1}{2}$, or $2\frac{1}{2}$ short of 20, we count (1, $\frac{1}{2}$); (2, $\frac{1}{4}$); ($2\frac{1}{2}$, $\frac{1}{8}$). In this process anyone can easily employ his own method of counting which he will certainly understand better than following mere printed instructions.

Solar Disturbances During April, 1908.

THE chart is constructed from the observations of Messrs. J. McHarg, A. A. Buss, and F. C. Dennett, compared with drawings by Messrs. A. Mee and E. Matthews. The longitude of the central meridian on April 1, was 241° 37′, the sun showed considerable activity.

No. 45 is a repetition from the previous month.

No. 47.—Two spots seen on the disc April 1, six next day, the preceeding spots soon collapsed, forming one 22,000 miles across. Rapid changes occurred, last seen close to the limb, 11th.

No. 47*a*.—A group of half-a-dozen pores broke out south of 47 on 6th, only one or two remaining until 7th.

No. 54.—A pore seen only on 10th.

No. 54*a*.—Similar pores 20,000 miles apart, seen only 11th to 13th.

No. 55.—A spot 5,000 miles in diameter 18th-27th, having a tiny companion on 22nd. In area of No. 34.

No. 55*a*.—A companion spot 7,000 miles diameter, involved in the same faculic disturbance. 19th-29th.

No. 55*b*.—A group of pores close to same area, 23rd-25th.

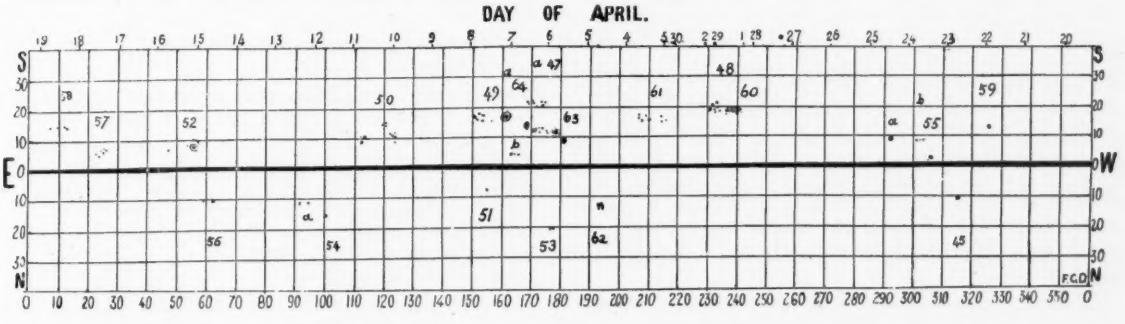
No. 56.—A pair of spotlets opened near the western limb, 19th and 20th.

No. 57.—A group of small spotlets seen 19th to 23rd.

No. 58.—A group of pores seen 20th and 21st.

No. 59.—A small solitary spot seen only on 21st.

No. 60.—A little group of pores came round the eastern limb before 22nd, and died out after 26th. In area of No. 48.



No. 48.—A group of tiny pores on 3rd, developing larger spots 4th, with a large penumbral spot in front, 6th-7th, forming a long group of pores, 8th and 9th. A larger spot opened in rear on 10th. 3rd to 11th.

No. 49.—Only two spotlets on 3rd, by 5th the leader had grown to 22,000 miles in diameter. 3rd to 13th. In area of No. 36*b*.

No. 50.—A group of spotlets 4th, looking at times like two groups. Only a pore seen 13th and 14th.

No. 51.—A pore seen only on 9th.

No. 52.—A spot 19,000 miles across; 9th-21st, which from 15th to 17th had quickly changing pores close round it.

No. 53.—Two minute pores seen only on 11th.

No. 61.—At first a spot with a smaller companion, but soon became a group of pores and dwindled away. 24th-1st.

No. 62.—Two spotlets and a pore on 29th, the pore only May 1, and three on 2nd. April 29th-May 7th.

No. 63.—A small solitary spot April 29th-May 7th.

No. 64.—A spot 11,000 miles in diameter, April 29th-May 10th.

No. 64*a*.—A spot 14,000 miles in diameter, forming with 64 a very similar pair to Nos. 55 and 55*a*. April 29 to May 11. In area of No. 49.

No. 64*b*.—A protean group of two or three pores, April 29 to May 12.

XUM

Photography: Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Animated Photography in Natural Colours.

It is now comparatively easy to make single photographs in "natural colours" in many different ways, but to apply any of these methods to cinematography is quite a different matter. It would, of course, be practically out of the question, at least at present, to prepare great lengths of film after the manner of autochrome plates, and if they were prepared it would be impossible to use them, because of their inherent want of sensitiveness. If the difficulties of exposing three films simultaneously through suitable colour screens were successfully met, it would be a practical impossibility by means of any construction of camera or triple lantern arrangement to work so perfectly that the red, green, and blue images from the three rapidly-moving films should exactly register on the sheet. And so one might proceed with other methods of colour photography and show how inapplicable they are to this purpose. But Mr. G. Albert Smith, of the Charles Urban Trading Company, has succeeded, by simplifying and modifying the ordinary three-colour projection method, until, in fact, this description is no longer applicable to it, in working out a practical method, in which the ordinary cameras and projection apparatus, and the usual film, are employed. The lack of red sensitiveness in the ordinary emulsion is overcome by the use of sensitisers. He omits the blue or blue-violet screen altogether, and although by so doing pure deep blues cannot be reproduced, the loss is hardly, if at all, perceptible, as blue is a dark colour. This leaves only the red and green screens to arrange for, and the colours he selects for these are different from those generally employed, the red being rather more orange and the green more blue. The colour screens are arranged on a disc that rotates against the film both during the taking and the projection, in such a manner that the images are taken and projected through the two colours alternately on the same film. The combination of the rapidly succeeding images, therefore, gives both the movement and the colour. In the demonstration given by Mr. Albert Smith a week or two ago, when he showed his first results, the colours, so far as one could judge of them, were excellently reproduced, and the whole result was very successful. This must be regarded as a distinct advance in cinematography.

The "Donisthorpe Photographic Process."

This is a system rather than what is commonly called a process, as it includes all the operations from the making of the negative to the production of the print. The system, shortly described, consists in developing the negative with metol, amidol, rodinal, or para-amidophenol, much as a bromide print would be developed, keeping the least exposed parts free from deposit, then causing the negative to absorb a dye solution and using it as a mechanical printing surface. After fixing and washing, the negative is dried, soaked in a hardening solution and rinsed, and then placed in the dye solution until it has absorbed a sufficient quantity of the colouring matter. The excess of the dye is rinsed away, and the prints are prepared by squeegeeing a wet piece of gelatine-coated paper into contact with the dyed negative, removing it after a few minutes, and washing it in methylated spirit and drying it quickly so that the dye may not spread in the film. After two prints have been taken the negative is re-dyed. Dyes of many different colours are available, and any of them can be washed out by immersion for ten minutes in running water. Lantern slides can be similarly prepared. At the time of writing, the materials are not quite ready for issue, but I have seen a print which would be difficult to distinguish by mere inspection from an ordinary toned silver print. The advantages of the system are chiefly that the materials are cheap, that no light is required for the printing, and that a large choice of colours is available. The nature of the print is obvious from the above description.

Toning Bromide Prints.

The desire to get a brown colour instead of the usual black or grey of the developed silver image has led to many methods of toning bromide prints. Uranium ferricyanide was, perhaps, the earliest reagent employed, but the uranium compound produced, though apparently permanent in negatives, is very susceptible to change in the thinner films of paper prints. The corresponding copper salt has some advantages, but also characteristic disadvantages. A copper-toned print stands washing better than one toned with uranium, but the colour is not always acceptable, and there is a liability to the production in a few months of an objectionable metallic appearance on the surface. The hypo. and alum bath, introduced many years ago by the Kodak Company, gives a colour that is appreciated, but it is very tedious to use unless it is heated. It appears that in this case the chief if not the only cause of the change of colour is due to the formation of silver sulphide. The more direct and certain change of the silver into sulphide by first converting the metal in a halogen or other salt, and then acting on the salt with a solution of ammonium of sodium sulphide, has the advantage that the changes are easy to bring about, they take place rapidly in the cold, and are quite definite—if due care is observed. The sulphide of ammonium or sodium has an odour that many people object to, and these salts are very likely to prove disastrous to sensitive material or even to finished printed-out silver-prints in their vicinity, as well as to other material in less degree, and they are therefore distinctly dangerous substances to introduce into a photographic laboratory. When combined with certain other sulphides, such as of tin or molybdenum, compounds are formed which are more stable, and may be regarded as harmless if treated with common care. These compounds act in quite a similar way to the simple sulphides, but doubtless the sulphide of the second metal is to a certain extent deposited when the silver salt is converted into sulphide by their means. This causes a little intensification of the image. The "cubrome thiomolybdate sepia toner," which Mr. H. E. Smith has rendered practically available is a reagent of this knid. It is easy to use and gives good colours, which may be modified somewhat by the addition of a little ammonia.

A Competition.

Messrs. Marion, of Soho Square, are offering several prizes from £50 downwards, for work done with their plates, films, and papers, during the present season. They include a class for photographs of a scientific character, which will doubtless interest many of our readers. Full details may be obtained on application to the firm.

NOTES.

ASTRONOMY.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

Systematic Motions of the Stars.

THE work done on this investigation by Kapteyn and Eddington has recently been extended by Professor Dyson, the Astronomer-Royal for Scotland. In this discussion he has chosen stars with large proper motions, the limits being from 22″ to 80″ a century, for the reason that if the stars are moving in two streams, these streams would be indicated more strongly by excluding stars of small proper motion; the effects of errors of observation are also eliminated to a great extent. Another important point is that the stars whose motions are being considered are well distributed over the whole sky, 157 being within 52° of the North Pole, 165 within 50° of the South Pole, and the remainder extending throughout a belt 30° N. and S. of the equator. These 1,100 stars have been treated as belonging to eight different areas, and their proper motions found as projected respectively on the tangent planes at the Poles, and the tangents at the equator at the points 0^h, 4^h, 8^h, etc., etc. The resulting values are then shown graphically, and strongly support Kapteyn's hypothesis that the stars are moving in two streams, the quick-moving stars here considered showing the streams in a very pronounced manner, specially noticeable in the case of Stream II. The positions found by the three observers for the apices of the streams are:

	Stream I.		Stream II.	
Kapteyn	R.A. = 85°; Decl. = −11°S.		R.A. = 260°; Decl. = −48°S.	
Eddington ..	90°	−19°	292°	−58°
Dyson .	94°	− 7°	240°	−74°

—*Royal Soc. Edinburgh Proceedings*, Vol. 28, Part 3, February, 1908.

Spectroscopic Determination of the Sun's Rotation.

Special investigations have been made by Mr. W. S. Adams, at the Mount Wilson Solar Observatory, to determine the law of rotation of the hydrogen constituent of the solar atmosphere. The photographs were taken with the 30-foot Littrow spectrograph, by means of which the slit could be adjusted to any position angle on the sun's image. The plates include the Lines Hα, Hγ, and Hδ, those of Hα being in the second order grating spectrum, and those of Hγ and Hδ in the third order. Each exposure consists of a spectrum of the limb with a spectrum of the centre on either side, and points on the limb 180° apart are taken alternately. Two important conclusions are derived from a discussion of the observations. The rotational velocity of the hydrogen envelope is decidedly higher than that of the general reversing layer, amounting at the equator to 1° in the angular motion. Further, at the level of the hydrogen gas it is found that the equatorial acceleration has practically ceased to exist. There appears to be a tendency for the values given by Hα to be higher than the velocities given by Hγ or Hδ, and this is in accord with the other known abnormalities of the Hα line in its width and intensity.

In close relation to the above, Professor G. E. Hale describes the examination of a long series of spectroheliograms of flocculi taken in hydrogen light, with the object of determining the rotation velocities at the levels of these particular vapours.

The spectroheliograms have been measured with the heliomicrometer, and although the results of the hydrogen flocculi are less accurate than the calcium flocculi, it is certain that no systematic variation of the angular velocity is shown, thus agreeing with the spectrographic determination of Adams, and indicating that the hydrogen in the sun does not share the equatorial acceleration observed in the case of sunspots, faculæ, calcium flocculi, and reversing layer.

Other collateral evidence for the high level of the hydrogen stratum is given by the relative displacement of calcium and hydrogen flocculi, the latter being in general displaced towards the limb by an appreciable amount, usually indicating a difference of level from one to two thousand miles. —(*Astrophysical Journal*, Vol. 27, pp. 213-229, April, 1908.)

Total Solar Eclipse, August 30, 1905.

The Director of the Marine Observatory of San Fernando has recently issued the report of the Spanish eclipse party stationed at Soria, about 100 miles north-east of Madrid, during the total solar eclipse of August 30, 1905. The chief instruments of the equipment included a Grubb equatorial 152 mm. aperture and 122 cm. focus; another Grubb equatorial 102 mm. aperture, 130 cm. focus; a Steinheil objective 148 mm. aperture, 266 cm. focus, used as a coronograph with amplifying lens giving a solar image 10cm. diameter on plates 40 by 40 cm.; a powerful prismatic camera, having a Secretan objective 90 mm. aperture, 137 cm. focal length, with two prisms by Steinheil of 45° angle and index of refraction 1.6215, arranged to take several instantaneous exposures successively on plates 18 by 24 cm.; slit spectroscopes with prisms and with diffraction grating. These instruments were fed with light by means of two clock-driven reflectors, a siderostat by Gautier of 40 cm. diameter, and a Mailhat coelostat with reflectors 30 cm. and 20 cm. diameter. A complete set of meteorological instruments and apparatus for determining the position of the camp was also included. Very beautiful photographs of the corona were obtained, four of which are reproduced in this report, showing the large group of prominences on the eastern limb, the inner corona with an exposure of 10 seconds, and the outer corona with exposures of 25 and 15 seconds. Photographs taken with the prismatic camera are also reproduced, showing the varying spectra, from the chromosphere at beginning of the total phase, then the spectra of the corona and higher prominences during totality, to the chromosphere again at the end of the eclipse. A list is included of 478 lines in the spectrum of the chromosphere, giving their origins and comparisons with Rowland's wavelengths.

Stars with Variable Radial Velocity.

ξ Ursæ Majoris.—Professor E. C. Pickering calls attention to the detection of marked irregularities on photographs of the spectrum of this star taken with the objective prism, and, owing to the difficulty when this instrument is employed of distinguishing between a true doubling and that due to a change in focus of the principal telescopes suggests that the star should be observed with a slit spectrograph.

η Virginis.—Forty-three negatives of the spectrum of this star were obtained by W. E. Harper at the Dominion Observatory, Ottawa, between February 22 and July 5, 1907. From the provisional elements determined from the measurements on these plates the following are deduced for the brighter component.

Period = 71·9 days.
Eccentricity = 0·40.
Velocity of system = + 22 km. per sec.
$a \sin i$ = 26,750,000 km.

During the period velocities observed range from −40 to +20 km. per sec.—(*Astrophysical Journal*, Vol 27, p. 160, March, 1908.)

β Ursæ Majoris.—From photographs obtained at Potsdam during the period 1903, March 15, to 1908, February 24, Dr. H. Ludendorff finds evidence of variable radial velocity in this star. The extreme velocities are −26 and −6 km. per second, with a period of 27 days.—(*Astronomische Nachrichten*, 4,239, March 27, 1908.)

Kodaikanal Observatory Report for 1907.

The report of the Director of the Kodaikanal and Madras Observatories for the year 1907 records the progress during

a very successful year, notwithstanding the adverse weather conditions during several months. The newly-appointed Assistant Director, Mr. J. Evershed, F.R.A.S., joined service on January 21, after a visit of inspection to the principal American observatories.

Spectroheliograph.—After the new moving roof was in position the instrument was in constant use from January 31. In April a new collimator slit was fitted and the camera slit modified, a device being introduced to facilitate setting the slit on any desired spectrum line and for automatically recording its exact position on the plate after each exposure. Photographs were taken on 300 days out of 334 possible observing days; on 45 of these the results were unsatisfactory on account of unfavourable weather. It is interesting to note that many excellent photographs were obtained when the conditions were apparently very unfavourable owing to strong sky-glare due to cirrus clouds. In general, only a short time is available in the early morning when the definition is good enough to secure fine detail in the photographs. Usually four negatives of the disc and two of the limb are taken each day. Measures are made of the position, angles and heights of the prominences.

Prominences.—These were recorded visually on 305 days as against 269 in 1906. The record is compared with that obtained with the spectroheliograph limb photographs. In the case of eruptive or metallic prominences the spectra are examined and the most conspicuous bright lines recorded.

Sunspot Spectra.—The record of the most widened lines was carried on until March 1, when the new scheme of observation organised by the International Union of Solar Research was adopted; for this particular attention will be given to the region $\lambda 4861$ to $\lambda 5210$, the affected lines being directly compared with Hale's photographic map of the sunspot spectrum. A photographic investigation of spot spectra has also been successfully carried out with two grating spectrographs. The plates show much detail and cover the regions D-F and $H\gamma$-$H\delta$.

Solar Photographs were obtained with the Dallmeyer Photoheliograph on 339 days. Negatives are forwarded to Greenwich as desired to fill up gaps in the series taken there.

General Observations.—(*a*) An investigation is in progress for determining the rotation period of the higher gases in the chromosphere. (*b*) Photographs of the spectrum of Comet Daniel (1907d) were obtained with a prismatic camera attached to the 6-inch Cooke Equatorial. (*c*) The chromospheric line $H\delta$ has been photographed under various conditions in order to determine its true wave-length. The results indicate that Rowland's value (4102.00) is about 0.10 unit too large. (*d*) Discussion of the prominence observations indicates that the general reduction of activity during 1907 was confined to the northern hemisphere, the southern actually showing a slight increase. In the latitude distribution a remarkable difference is shown between the two hemispheres, the northern polar prominences practically ceasing to exist from the beginning of the year, while in the southern hemisphere the whole region between -45° and the South Pole produced a considerable number of very large prominences. Metallic prominences were of frequent occurrence, those in high latitudes showing lines of sodium, magnesium, and iron, while those in the spot latitudes gave, in addition, lines of barium and calcium, together with a considerable number of unidentified lines, possibly including nickel, manganese, chromium, and titanium. (*e*) With the Milne horizontal pendulum seismograph only 24 distant earthquakes were recorded, which is by far the smallest number for any year since the instrument was installed.

BOTANY.

By G. MASSEE.

An Opium Substitute.

THE leaves of an indigenous tree, Poko biak (*Mitragyna speciosa*, Korth.), are stated in the *Journal of Federated Malay States Museums* to be used in Malaya as a substitute for opium. It is a medium-sized tree, with large leaves and balls of greenish-white flowers. It is widely distributed in Perak, and occurs in the jungle and is also planted by the natives in and around villages.

The drug is prepared in two distinct ways. In the first the leaves are dried in the sun until they become crisp, when they are reduced to powder by rubbing between the hands; the ribs and veins are removed and the powder stored for use. The dose is about 136 grains. The powder is mixed with cold water and the whole drunk, or an infusion is made with hot water and it is taken like tea. It is usual to take it twice a day before meals.

In the second method of preparation the leaves are dried in the sun, and then boiled in water to form an infusion. This is strained and the clear filtrate evaporated to a syrup. In this condition it can be kept for a long time. The syrup is mixed with hot water before taking. The dose is 5.83 grains. Some people just put it on the tongue and wash it down with a drink of water.

The extract is also smoked, after being intimately mixed with the finely shredded leaves of the Palas palm (*Licuala paludosa*). The mixture forms a sticky, fibrous, brown mass.

It is a much worse form of drug habit than opium smoking, the effects on its habitual devotees being far more deleterious.

The use of the leaves has previously been erroneously described in this country as a *remedy* for the opium habit.

Dry-farming in Syria and Palestine.

An account is given in the Transactions of the Agricultural Society of Germany of the method of farming adopted in the dry and unirrigated land in Syria and Palestine.

From the beginning of April until October there is practically no rain, yet in July the fields teem with a vigorous growth of sesame, watermelons, tomatoes, cucumbers, etc., all flourishing without artificial watering, although at that time no rain has fallen for many weeks. In fact, the Syrian peasant, from the moment his seed is sown, prays diligently that no rain may fall. During the period of growth of a crop the surface of the soil to a depth of six or eight inches is perfectly dry and loose. Below this surface layer will be found moist soil in which the roots extend and grow vigorously. In this moist subsoil plants continue to grow until late autumn.

When the crop is removed in the autumn the rains commence, and the land is ploughed after each heavy rain as soon as the soil begins to dry. Two primary objects are kept in view in ploughing, to furnish a favourable surface for taking up all the water, and to prevent its upward evaporation from the subsoil. The great point is to keep the upper six inches of soil perfectly loose and friable, so that the moisture from below is not drawn upwards and lost in evaporation, but does not ascend higher than the compact subsoil that is not broken up by the plough. For this reason the ploughing is shallow, averaging from four to six inches in depth.

When the time for sowing the seed arrives the land is ploughed to a depth of about six inches, and the seed is sown from an arrangement attached to the plough, falls on the damp subsoil, and is covered by the soil closing over behind the ploughshare. From this time the upper stratum of loose soil prevents the escape of moisture upwards beyond the wet subsoil on which the seeds rest, and into which their roots, after germination, spread.

A New Rubber-yielding Tree.

Dubard and Everhardt give an account in *Comptes Rendu* of the discovery in Tonkin of a new species of *Bleckrodea*, called *B. tonkinensis*, belonging to the Urticaceæ, the latex of which contains a large proportion of caoutchouc of the highest quality.

B. tonkinensis is a tree attaining to a height of 10 to 15 yards, much branched, leaves oblong, stipulate; flowers monœcious, forming cymes more or less condensed into heads. The male flowers are often grouped around a central female flower.

This is the first rubber-producing tree discovered in Indo-China.

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CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

Colours of Iron Oxide.

WHEN the ordinary yellowish-red ferric oxide is heated with sodium chloride it is transformed into a violet-coloured substance, and a similar change is effected by the presence of other salts such as borax, calcium chloride, etc., the final iron product in each case still consisting of ferric oxide. The nature of this change has been studied by Herren Wöhler and Condrea, who find that the rate of cooling and the presence or absence of air have no influence upon the results. At least 6 per cent. of the added salt is required to produce the maximum intensity of colour, the minimum temperature required corresponding to the melting-point of the salt. When moisture is present the change in colour takes place at a lower temperature. The cause of the alteration in colour appears to be due to the formation of larger particles of iron oxide brought about by agglomeration under the influence of the fused salt. In the technical preparation of iron oxide colours ordinary salt is commonly employed, but in the light of these results the use of the lower-melting borax would result in a considerable economy of fuel.

The Phosphorescence of Phosphorus.

It has been shown by Dr. E. Scharff that the phosphorescence of phosphorus is due to oxidation, with the formation of a trioxide of phosphorus. The phenomenon is intermittent and may be made reversible by increasing the pressure of oxygen beyond a certain point, the phosphorus then becoming non-luminous. If the phosphorus be placed in oxygen under a pressure just insufficient to extinguish the phosphorescence the trioxide vapour forms a mixture with the oxygen which ignites spontaneously, and a fresh portion of this inflammable mixture is then slowly formed again. By reducing the pressure of the oxygen the successive formation of the mixture and its combustion occur at shorter intervals, so that finally the light appears continuous. At this stage there is a rapid increase in temperature and the phosphorus takes fire. But this may be checked by once more increasing the pressure of the oxygen, and the phosphorescence then dies out.

The Fat of Rabbits Fed with Cotton-seed Oil.

There is a very sensitive test for cotton-seed oil, which is given by no other oil. This is known as Halphen's reaction, and is characterised by an orange-red coloration which is obtained when the oil is heated with a mixture of amyl alcohol and carbon bisulphide in which a little sulphur has been dissolved. So characteristic is this test that it is widely used as a means of detecting the presence of a small proportion of cotton-seed oil in butter or other fats. The fact of a faint positive reaction being given by butter is not, however, proof positive of adulteration; for it has been shown by Herr Werenskiold that a cow to which has been given a daily portion of 1 kilo. of cotton-seed meal produces butter that will give the reaction for cotton-seed oil. The vegetable oil may also be deposited in the body fat of an animal, as has been shown by various experiments, of which the most recent are those of Herr Landrich. In these experiments five rabbits were fed continuously with cotton-seed meal, others with food mixed cotton-seed oil, whilst others were inoculated every eight days with the oil. In all cases it was found that the presence of the vegetable oil interfered with the deposition of fat in the animal, and that the composition of the fat that was deposited was manifestly altered through the influence of the cotton-seed oil glycerides. Halphen's reaction was invariably obtained with the fat, but when the feeding with the oil was discontinued the substance in the oil to which that reaction is due gradually disappeared in a short time, although the fat of the animal did not regain its normal composition until considerably later.

GEOLOGY.

By EDWARD A. MARTIN, F.G.S.

Valleys of Solution.

IN a paper read before the Geological Society on "Solution-Valleys in the Glyme Area of Oxfordshire," the Rev. E. C. Spicer, M.A., F.G.S., offers the suggestion that these were formed by solution rather than by mechanical erosion. This area is part of the gently tilted Great Oolite limestone-plateau, which is indented by a number of sunken valleys that show no marks of erosion, but appear to be subsidence valleys. They begin suddenly at any part of the area, and descend with sinuous curves to a main valley into which they open quietly without disturbing the main valley's contour, and without bringing any surface-débris. The main valley likewise enters a stream-valley in a similar manner. The stream-valley quietly develops into a broad sinuous river-valley, with a floor, level in transverse section, over which a small river-stream aimlessly meanders. The plateau area is quite free from drift or gravels, and from any of the usual marks of surface denudation, although the valleys have strongly marked cross sections. There are no marks of marine currents, of fluvio-glacial scour, or of ice. There are no wind-gaps suggesting beheaded streams, or any evidence of vanished heights that could produce torrents sufficiently strong to carve out the present surface. At the mouths of several of these dry winding valleys there are issuing streams strongly impregnated with lime-carbonate. Mr. Spicer suggests that percolating water forming an underground course along joint lines removes enough material in solution to weaken a long, narrow, winding area over which the surface subsides until the underground stream is revealed. It does not appear possible to reconstruct any local conditions that could have produced these valleys by mechanical erosion, and it is suggested that they are formed by underground solution, and are, therefore, called "Joint Valleys" or "Solution Valleys." Prestwich estimates that 143 tons of lime-carbonate are annually removed from every square mile of the limestone area drained by the Thames. This would give an annual amount removed by solution from the small Glyme area of over 10,000 tons.

Palæoliths from Frant, Sussex.

The photograph which accompanies these notes shows two well-made arrow-heads and a lance-head, which were discovered by Mr. Lawrence in the neighbourhood of the village of Frant, just within the northern boundary of Sussex. In consulting various authors who have written on this subject one cannot help being struck by the dearth of well-formed arrow-heads with barbs from the south of England. Ireland has furnished examples, but I am unable to trace the finding of such beautiful specimens as are here illustrated in the southern counties of England. The chipping on all three specimens is extremely delicate, and one can imagine that the cunning workman who chipped them must have devoted much time and labour to them. The photograph brings out the details well. The flakes which have been removed are very small, some measuring not more than a sixteenth of an inch across. A slight error of judgment on the part of the palæolithic workman might have spoiled the symmetry of the implements. A blow struck but slightly out of the direction intended might have removed a large part of the edge, and produced an unsymmetrical flint. The willow-leaf implement is the most perfect of the three. This and the barbed arrow-head on the right, which has lost the point, are translucent, and are of a dull smoky quartz colour. The third is of the familiar slaty flint colour, and bears no resemblance to quartz, and is not translucent. The edges of the flakings are but slightly worn down. The best and hardest flint seems to have been selected for working, such as, indeed, only the choicest and most perfect implements would deserve, and such as would alone be worthy of being utilised by such clever workmen. It is noticeable that the barbs of the two barbed arrow-heads have been produced in the first place by two holes being bored, leaving a piece of flint between them to form the shaft of the arrow-tip. These holes could only

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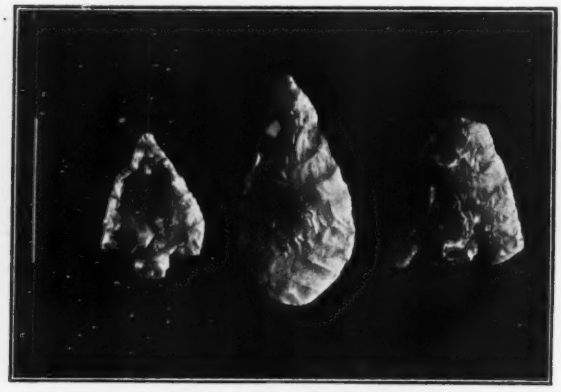
have been bored by another piece of flint, pointed for use as a borer. It would seem probable that the shaft of the specimen on the right was damaged in making these holes, or, at any rate, in removing the superfluous flint at the foot of the holes, so as to leave the barb complete. Those portions of the holes remaining are so completely circular, and polished, as to suggest that the holes were bored with a rotary motion of the borer, and not by a sudden blow. Various attempts have been made to classify the numerous types of implements, but most of these have been on admittedly insufficient data. Palæolithic implements are conveniently referred by some to three principal types, those of



Arrow-heads and Lance-head from Frant, Sussex.
The white line represents an inch.

(1) St. Acheul; (2) Moustier; and (3) Solutré, and from the skill and delicacy of the chipping we must class our specimens with the last-mentioned, the implements used during the "reindeer period." How did these specimens reach Frant? The chalk is some miles distant, but flint implements travelled far in those days, and seem to have been bartered all over the world. From London to the Cape, from Paris to Algeria, from Nineveh to Japan, and on the banks of the Ohio and the Mississippi they have been found. We need not then wonder at their being found in Sussex, only a few miles distant from the chalk hills, the natural matrix of flint. I am indebted to Mr. H. D. Gower for kindly photographing the specimens.

METEOROLOGY.

By WILLIAM MARRIOTT, F.R.Met.Soc.

The April Snowstorms.

THE weather immediately following Easter will long be remembered for its intense cold and snowstorms; the last week of April was, in fact, the most ungenial of any week in April for very many years past. Dr. H. R. Mill, in "Symons's Meteorological Magazine," gives an account of the snowstorms during this period. On the 23rd about a foot of snow fell over a part of Hertfordshire, Essex, and Suffolk.

The worst of the snowstorms was that experienced on Saturday, the 25th, when a gale of unusual severity was blowing in the Channel, and railway communication was much hampered in several parts of the South of England. At Reading the railway service was disorganised, and at Southampton work at the docks was brought to a standstill. At Oxford the depth of snow was 17 inches. Throughout Oxfordshire, Berkshire, and the north of Hampshire, traffic by road was completely stopped, the carriers who supply the outlying villages had in several instances to leave their carts in the drifts and make the best of their way to shelter on foot, leading their horses. Many observers in these counties refer to the great snowstorm of January, 1881, as the only occasion when a storm of greater severity occurred, but, fortunately, this year's storm proved of much shorter duration. The thaw, when it occurred, naturally gave rise to a severe flood in the Thames, though, fortunately, the upper tributaries of the river lay beyond the region of heavy snow, so that only the middle courses of the Cherwell and Kennet were subjected to a great rush of snow-water.

Upper Air Observations in Egypt.

At the meeting of the Royal Meteorological Society, held on May 20, Mr. B. F. E. Keeling, Director of the Helwan Observatory, gave an account of the Upper Air Observations which are being carried out in Egypt. He said that Egypt itself has comparatively little weather at all, and what there is has no influence commercially except along a narrow belt on the Mediterranean coast, but, on the other hand, the whole prosperity of Egypt is wrapped up in the weather of the neighbouring country of Abyssinia. As the summer rainfall is greater or less in Abyssinia, so is the Nile flood, and, in consequence, the area of land cultivated and the general prosperity is greater or less. In years when a bad low stage of the river is to be expected following on a bad flood, the early spring showers in Abyssinia are then of very great importance. As, unfortunately, there is no meteorological service in Abyssinia, it is not possible to obtain information about the rainfall over that region, so steps have recently been taken to obtain observations on the upper air over Egypt by means of pilot balloons and kites. Mr. Keeling gave an account of the methods employed, and of the directions in which it was hoped in the near future to develop the work. He also stated that the observations of the anti-trade winds made by M. Teisserenc de Bort and Mr. A. L. Rotch have been confirmed. At Helwan the anti-trade wind is reached at a height of about 6,500 feet above sea-level. The greatest height so far reached by a balloon was 54,000 feet, and on that occasion the south-west anti-trade wind was apparently penetrated and a north-west upper current encountered.

Colour of Lightning.

Mr. Spencer C. Russell read a paper before the Royal Meteorological Society on "Observations on the Colour of Lightning made at Epsom 1903 to 1907." He said that he had for the past five years kept a record of the colours or series of colours noted during each thunderstorm or display of sheet lightning, and tabulated them under their respective colour. He had thus results of observations of "forked" lightning made during 57 thunderstorms, and 78 observations of "sheet" lightning. It appears that in forked lightning red is the colour of the most frequent occurrence, and this is followed closely by blue, the least frequent colours being orange and green. White is of the greatest frequence in sheet lightning, red and yellow being next. It seems that the presence of hail, when occurring in association with a thunderstorm, is intimately connected with blue lightning.

The late Mr. G. J. Symons, in the years 1857-59, collected a number of returns on thunderstorms from observers in various parts of the country. On separating the records into the two classes of "sheet" and "forked" lightning, he found that in sheet lightning the most prevalent colour was white, then yellow, blue, and red; in forked lightning, however, the order was nearly reversed, blue being more than twice as frequent as any other colour, then red, white, and most rarely yellow. Blue (or violet) was by far the most frequently recorded colour. In every case but two where he had received communications from persons who had been themselves, or whose houses had been, struck by lightning, and the colour had been mentioned, it was stated to be blue or violet.

As the thunderstorm season is now approaching, it is desirable that observers should be on the alert to watch and make notes of the various phenomena.

The Fernley Observatory, Southport.

Many health resorts and seaside towns have regular meteorological stations, but none of them come up to that at Southport, which, if not in name, is in fact a first-class observatory. This is no doubt due to the enthusiasm and skill with which Mr. Baxendell has carried out his duties

as "Meteorologist to the Southport Corporation." Apart from the instruments required for a regular meteorological station, this observatory includes in its equipment a large number of self-recording instruments such as are hardly to be found at any other observatory. Among these are barograph, thermograph, hygrograph, anemoscope, anemograph, rain gauge, and sunshine recorder—most of these are in duplicate, as it is the practice at this observatory to employ continuously two self-recording instruments for each of the more important meteorological elements.

The Fernley Observatory is in Hesketh Park, the anemographs are at the Marshside Fog-Bell Station, which is over a mile to the north-north-east, and the evaporation tanks are at Barton Moss, about 5½ miles to the south-south-west.

The report containing the results of the observations for the year 1907 has just been issued. The following are the principal results:

1907.	Temperature.		Sunshine.	Rainfall.		Evaporation.	Wind.
	Mean.	Daily Range.	Hours.	Total.	No. of Days.	Total.	Daily Movement.
	°	°		ins.		ins.	
January..	39·4	7·6	53·7	1·28	15	·32	392
February	37·2	10·1	98·2	1·70	14	·38	377
March ..	43·4	13·5	178·0	2·70	15	1·44	376
April ..	45·7	13·3	162·8	1·60	16	1·98	346
May ..	50·7	12·5	151·5	3·23	22	2·75	342
June ..	54·7	10·7	150·3	5·92	24	3·37	419
July ..	57·7	12·3	213·1	1·78	15	3·23	278
August ..	57·5	10·3	163·1	3·70	18	2·99	415
Sept. ..	57·1	13·8	127·7	·75	4	1·81	251
October..	49·9	11·7	87·5	3·80	23	1·05	295
Nov. ..	43·7	10·2	53·1	2·74	20	·42	282
December	40·3	8·1	34·8	3·43	20	·47	377
Year ..	48·1	11·2	1473·8	32·63	206	20·21	346

The report also contains tables giving the mean hourly results of barometric pressure, temperature, direction and velocity of the wind, and the duration and amount of rainfall. The influence of land and sea breezes comes out very clearly, for the most prevalent wind was the S.E. from 9 p.m. to 9 a.m., and the W. from 10 a.m. to 6 p.m.

An appendix contains tables giving the average hourly results of the direction and velocity of the wind for the five years 1902-1906.

Ships Struck by Lightning.

Ships remote from the land are seldom damaged by lightning, despite the fact that some of the most awe-inspiring displays of atmospheric electricity are frequently witnessed by those on board of them. Standing rigging, and even parts of the running gear, is now made of steel wire, and this substitute for the old-fashioned hemp serves the purpose of a lightning conductor when the ship is not fitted with such an aid to safety. The electric current is conveyed down the wire rigging, and reaches the sea through the vessel's metal hull. Damage only occurs if the current be interrupted on its way to earth. In a comparatively large proportion of instances the fore-royal truck is struck by lightning, that of the main less frequently, and the mizen least of the three. Very serious casualties under this head occurred to warships and merchant vessels in the days of wooden hulls and hempen rigging. In the last issue of the "Monthly Meteorological Chart of the North Atlantic" it is stated that in July, 1802, as thirteen sail of the East India Company were trying to round the Cape in the vicinity of Algoa Bay, homeward bound, two of them, the *Britannia* and the *Bombay Castle*, were struck by lightning. The foremast of each was soon enveloped in flames, and the two masts had to be cut away in order to save the ships and their combustible cargoes. A heavy gale was blowing, the night was dark, and the other ships of the fleet, which were hove-to at the time, were witnesses of this thrilling incident.

Many vessels are now fitted with lightning conductors of approved types, lest the wire rigging should fail to carry off the electric current. In May, 1896, shortly after a severe thunderstorm accompanied by lightning and rain in 3° S. 87° E., the P. and O. steamship *Victoria* had a sudden increase of deviation amounting to 6° in both the standard and the wheel-house compasses, and later on it was discovered that the lightning conductor on the fore had fused. The ship must have been struck by lightning during the storm. At 10.55 on the night of December 29, 1907, in 35° 50′ N. 21° 20′ E. the P. and O. steamship *Britannia*, outward bound to Sydney, N.S.W., came under the influence of a heavy thunderstorm, accompanied by vivid lightning, a deluge of rain, and very large hailstones. A strong W.N.W. breeze was blowing, the external air temperature in the shade was 60°, and the corrected and reduced barometer reading was 29.67 ins. This weather continued till 5.30 on the morning of the 30th, in 35° 0′ N. 23° 20′ E., and it was discovered that during the night the fore lightning conductor had been fused in places, and that the strands of the last 10 feet of it had been opened out. Neither the *Victoria* nor the *Britannia* was injured, and this immunity from injury was doubtless due to the presence of lightning conductors.

ORNITHOLOGY.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The British Ornithologists' Union and Bird Protection.

At the annual meeting of the British Ornithologists' Union, held on May 20, Mr. H. F. Witherby put forward a motion to secure the expulsion of members of the Union who were guilty of taking the eggs, or shooting the adults, of such of our native birds as are in danger of extermination. It is an uncomfortable reflection that the premier Ornithologists' Society of this country should find it necessary to frame such a motion, but, nevertheless, there are, unhappily, a few members who, possessed by an insane desire to possess eggs of our rarer and fast vanishing species, think lightly of the harm they are likely to do by such discreditable conduct.

But so grave and drastic a measure requires careful consideration, and it was, therefore, decided to leave the matter in the hands of a special committee, who will, in the autumn, lay before the Society their recommendation as to what steps shall be taken in the matter.

Hoopoe in the Isle of Wight.

The Rev. John M. Patterson writes to the *Field*, May 9, to record the fact that he saw a Hoopoe on April 29 at Freshwater, Isle of Wight. So far no one seems to have achieved the glory of having killed this bird, but then the danger of such an announcement may account for this!

Golden Oriole in Surrey.

An anonymous writer in the *Field*, May 9, describes a bird seen by his daughter on March 26 in a garden at Camberley, Surrey, which in every way answers to the description of this beautiful bird. The Oriole, it must be remembered, has more than once nested in Great Britain, and would probably more frequently do so if allowed.

Woodchat in Cornwall.

Mr. Geoffrey H. Coles, in the *Field*, May 16, records the fact that on May 13 he saw a Woodchat on the downs near Sennen. From his description there can be no question as to the correctness of his identification. Altogether about 40 instances have been recorded of the occurrence of this bird in Great Britain.

Schlegel's Petrel in Cheshire.

At the last meeting of the Zoological Society, May 12, a fine male specimen of Schlegel's Petrel (*Œstrelata neglecta*) was exhibited, which had been picked up dead in a field near Tarporley, Cheshire. Thereby a new bird has been added, not only to the British list, but the European avi fauna, for this makes the first recorded occurrence of this Petrel north of the equator. This bird, it is to be remarked, is a native of New Zealand, so that its occurrence so far out of its course is a very extraordinary one.

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PHYSICS.

By PROFESSOR A. W. PORTER, B.Sc.

New Dark Space in Helium.

AT the Royal Society *soirée* Mr. F. W. Aston exhibited a vacuum tube displaying the new dark space recently discovered by him. This is a narrow dark space closely surrounding the cathode in a tube containing helium at about 3mm. pressure. Two other dark spaces are known; these are the Faraday dark space, which separates the positive column from the negative glow, and the Crookes' space, which in most gases separates the negative glow from the cathode. In the tube shown the electrodes are of aluminium, the cathode consisting of a large flat plate. A continuous current of low density is passed through. Under these conditions the Crookes' dark space is ill-defined and filled with a greenish glow, while next to the cathode is seen a narrow region of intense darkness sharply defined. The fall of potential across this new space seems to be invariably about 30 volts. A slight inequality in the light has also been observed in hydrogen, and the corresponding fall of potential is about 15 volts. Possibly the new space is the distance the electrons have to move before acquiring sufficient velocity to ionise the gas.

Photoelectric Effects.

At the same *soirée* Dr. J. A. Fleming exhibited the electric effects arising from the action of light upon a potassium-sodium alloy. It is well known that this alloy and the alkali metals generally when sealed up *in vacuo* exhibit marked photoelectric effects. Indeed, it has been shown that when light shines upon these metals under these conditions electrons are shot out with explosive velocity, comparable with, though not so great as, the velocity of light. The alloy is enclosed with an insulated platinum plate in an exhausted tube. If the plate and alloy are connected to a galvanometer and the surface of the alloy is illuminated by an arc lamp an electromotive force of about 0.8 volt is created and a current produced through the galvanometer. This takes place only when light is incident. Differently coloured lights have markedly different effects. Thus if a violet screen is interposed between the arc and the alloy the galvanometer needle is strongly deflected. On the other hand, an orange glass screen cuts the effect off almost entirely. The various effects of light polarised in different planes can also be exhibited. Although much has been done previously in connection with this subject so that the facts themselves are not altogether new, this simple apparatus is of very great interest on account of its extreme elegance and simplicity.

Resonance Spectra of Sodium Vapour.

Sodium evaporated in the absence of other gases in a long steel tube exhibits a very complicated absorption spectrum when white light is passed though it and spectroscopically analysed. If, on the contrary, it be illuminated with white light, an equally complicated fluorescent spectrum is obtained. Professor R. W. Wood, who has studied these spectra, believes that the fluorescent spectrum is an exact counterpart of the absorption one. These spectra are both so complicated that they baffle the investigator who tries to unravel their meaning. Professor R. W. Wood has recently made the noteworthy discovery that if monochromatic light be thrown upon the vapour, instead of white light, the emitted light consists of a series of bright lines spaced at very nearly equal intervals along a normal spectrum and separated by a distance equal to about 37 Angström units. *Various series of lines with varying distribution of intensity can be brought out by changing the wave-length of the incident light.* In every case light of the same wave-length as that of the exciting light is emitted by the vapour, and, in addition, a large number of other frequencies which bear a definite relation to each other. In the absence of the exciting light the vapour is non-luminous; the monochromatic radiation disturbs the electrons in such a way as to produce light. He calls such spectra *Resonance spectra.*

The Active Deposit from Radioactive Substances.

Rutherford found that at atmospheric pressure the "excited activity" from radium emanation travels in great part to the negative electrode when an electric field is applied; at the same time, however, a small quantity (about 5 per cent.) goes to the anode. This means that while the "activity" must be positively charged in the main, yet negative charges must be carried by some of the particles of which the active deposit consists.

Mr. Sidney Russ has recently carried out an investigation to test whether these statements would still be true when the atmospheric pressure is reduced. He finds that whereas the activity of the cathode decreases as the pressure is diminished, the anode shows an increase in activity. The rod which had served as anode or cathode was then made a neutral pole by connecting it to the containing vessel, and what may be called diffusion experiments, *i.e.*, with no electric field existing in the gas, were made. Observations showed that there is a marked decrease in the amount of the active deposit that diffused on to the rod as the pressure is diminished.

When the surrounding gas is hydrogen just as much is deposited on anode and cathode within a range of pressure of .1 mm. to 1 mm.

ZOOLOGY.

By R. LYDEKKER.

A Curious Hybrid.

DURING the Easter holidays a very remarkable hybrid was temporarily deposited in the Zoological Society's Gardens. It was received a short time ago by Mr. Hamlyn, the well-known animal dealer, and at first reported to have been brought from the "hinterland" of the Gaboon district, on the West Coast of Africa. Smaller than a lion, but larger than a panther, this hybrid presents characters suggesting it to be a cross between these two species. It is, for instance, spotted, but the spots are for the most part brown (in place of black), and do not take the form of rosettes except on certain areas, while the tail is basally like that of a lion and terminally like that of a leopard. Information subsequently received leaves little doubt that the creature is a menagerie-bred hybrid, combining—in two generations—the blood of the lion, the leopard, and the jaguar.

Additions to the British Fauna.

In the April number of the *Zoologist*, Mr. R. S. Bagnall records the capture on the beach, under seaweed, near Barnstaple, of a small white woodlouse, which he identifies with a rare continental species known as *Armadillidium album*, and not previously recognised as a member of the British fauna. Turning to rodent mammals, it will be remembered that a few years ago, Mr. J. G. Millais had the good fortune to discover in Orkney a new species of short-tailed field-mouse, or "vole," which he subsequently described as *Microtus orcadensis*. Later on, an allied field-mouse from the island of Sanday, also in the Orkneys, was described by the same gentleman as a local race of the former species, with the name of *M. orcadensis sandayensis*. Mr. G. S. Miller has, however, noticed that the Sanday field-mouse differs from the true *orcadensis* by its more depressed skull and the frequent presence of a slight peculiarity in one of its molar teeth. On this ground, in a paper published in the January number of the "Annals and Magazine of Natural History," he raises it to the rank of a substantive species, *M. sandayensis*, of which at the same time he describes a local race from the island of Papa Westra, with the designation, *M. sandayensis westræ*. It may, however, be legitimately asked whether such refinements in classification are advisable or conducive to the real progress of science, and whether the case would not be fully met if the three forms in question were respectively

termed *M. orcadensis*, *M. o. sandayensis*, and *M. o. westræ?* In the same paper, Mr. Miller also describes as new the short-tailed field-mouse inhabiting the island of North Uist, in the Hebrides, as a race of the ordinary British mainland species, under the name of *M. agrestis insul.*

New Race of the Quagga.

As it was in "KNOWLEDGE" that I gave names to what at the time appeared to me to be local races of the extinct South African quagga (*Equus quagga*), it is fitting that the description of another supposed local form of the same species should be noticed in this column. For the two supposed new races I suggested the names *E. q. greyi* and *E. q. lorenzi;* the former name being in honour of the late Sir George Grey, the donor of one of the last survivors of the species to the London Zoological Gardens. Later on, my friend, Mr. R. I. Pocock, who added a third to the number of these presumed races, pointed out that a quagga in the museum at Paris appeared to be in many respects between my *greyi* and *lorenzi*. To this Paris specimen, together with another in the museum at Turin, Dr. L. Camerano, in a recent issue of the Acts of the Turin Academy, has given yet another race-name, *E. quagga trouessarti*. Surely this is going a little too far; as the evidence of the Paris and Turin specimens would seem to be in favour of regarding *greyi* and *lorenzi* as inseparable. The Italian specimen, according to the plate accompanying Dr. Camerano's paper, is a terrible "guy"; and it is scarcely too much to ask that the authorities of the Turin museum should forthwith have it remounted by the best taxidermists in Europe. Such relics of a bygone species are in a sense international property; and no trouble or expense should be spared in their proper mounting and conservation.

A Giant Isopod.

A recent issue of the *Memoirs* of the Indian Museum, Calcutta, contains a description of the anatomy of the *Bathynomus giganteus*, the largest known isopod crustacean, the type specimen of which measures 9 ins. long by 4 ins. broad. It was dredged by the U.S. s.s. *Blake* in 955 fathoms north of the Tortugas; a depth exceeding by more than 200 fathoms the greatest depth at which any specimen was taken by the Indian s.s. *Investigator* (740 fathoms). In the position and size of its eyes *Bathynomus* is remarkable, which leads the author of the paper to conclude that they are useful for the perception of light, and thereby support the theory of abyssal light, *Bathynomus* being essentially a deep-water form and not apparently a recent emigrant from shallow waters.

Papers Read.

The communications read at the evening meetings of the Zoological Society in April were for the most part of an extremely technical nature, and chiefly interesting to specialists. Two of those taken on April 7 were referred to in last month's issue, but there was also one by Mr. H. R. Hogg, on certain Australian spiders. On April 28, Mrs. E. W. Sexton discussed a certain amphipod crustacean genus; Mr. C. L. Boulenger described the breeding-habits of a fish from the Nile; Mr. C. T. Regan reviewed a certain group of sharks; while Mr. G. A. Boulenger did the same for a group of toads.

AERONAUTICS.

IN consequence of the important meeting of British and foreign aeronauts which is to take place on Saturday, May 30, the publication of the next number of "Aeronautics" will be postponed for a few days in order to allow of reference being made to the gathering under the auspices of the Aero Club, and to the combined balloon ascents from Hurlingham.

Science at the Franco-British Exhibition.

The "Knowledge" Exhibit.

THE Science Building at the Franco-British Exhibition is designed to accommodate collections and exhibits relating to all branches of science, and now that the building itself is completed and the collections are all in position, this valuable and novel departure will be of the greatest interest and usefulness. It is, however, altogether too soon to speak of it yet, and for the present we desire only to draw attention to the exhibit furnished by "KNOWLEDGE," which is to be found in the second of the entrance halls leading from the principal entrance in the Uxbridge Road. It is the intention of the directors of "KNOWLEDGE" to change the details of their exhibit from time to time, so as to make it representative not only of the character and contents of "KNOWLEDGE," but of novelties in invention and of current events in the scientific world. For the present, in addition to photographs relating to the subjects dealt with in our periodical, such as Aeronautics, Astronomy, Botany, Physics, Chemistry, Natural History, Microscopy, Meteorology, and Photography, there are several models or objects which are typical of recent work in discovery and invention. The most conspicuous of these is, perhaps, the "Radium Clock" lent by Mr. A. C. Cossor. The clock depends for its action on continuous emanation of energy from radium. A tube containing a minute quantity of radium is placed in a vacuum vessel in connection with a leaf electroscope. The constant leakage of energy from the radium charges the leaves of the electroscope with similar electricity, and the two leaves repel one another and separate. When they are far enough apart they touch small plates on either side of them which are connected with the outer atmosphere, and the electricity with which the leaves are charged is at once discharged. The leaves, therefore, fall together again and the process is repeated. The intervals of re-charging and discharging are approximately regular, and consequently the "fall of the leaf" may be compared to the beat of a pendulum, though it takes place at very much longer intervals. The emanations of radium are believed to be continuous for many hundreds or even thousands of years, so that except for the decay or breakage of the instrument or its parts, there is no reason why the "Radium Clock" should cease its action. It is a nearer approach to continuous or "perpetual motion" than any mechanism ever devised.

A number of interesting stereoscopic exhibits have been contributed by Mr. C. E. Benham, of Colchester. These are described as follows:—

Pinhole Stereograms.—These are produced by a stereoscopic camera, which, instead of having lenses, has two minute pinholes about 2½ inches apart for the purpose of forming the two images. By this means a very exact rendering of natural perspective and solidity is obtained free from the "edgeness" so often characteristic of the ordinary stereogram. There is also much less strain on the eyes on viewing pinhole stereograms than in looking at those produced with lenses.

Polarisation and Other Stereograms.—These are drawn stereoscopically by hand. The same ground plan and elevation are used for each drawing, and both are executed in accordance with the ordinary laws of perspective, but in one case the station point of the observer is removed about 2½ inches. Thus a perspective drawing appropriate for each eye is produced, and the stereoscope blends the two images into an appearance of a solid object.

"*Giant Vision*," that is, as things would appear if the eyes instead of being less than three inches apart were separated by many feet of space. The effect is that buildings, trees, etc., look like small models. The stereograms are produced by using two cameras placed twenty or thirty feet apart and directed upon a distant landscape.—*Vide* "ILLUSTRATED SCIENTIFIC NEWS," October, 1903.)

In addition to the foregoing there are exhibits of Liquid Air; of the new Auer alloys which have the extremely curious effect of producing showers of sparks when struck by a harder substance, such as steel; of aeroplane and airship models; and of the various publications associated with "KNOWLEDGE."

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, B.A., F.R.M.S.

(*Continued from page 114.*)

The Preparation of Microscopical Objects.

Cutting Sections by the Paraffin Method.—I have already dealt with the relative advantages of the paraffin method, as compared with the freezing and celloidin methods, and have explained why this method is by far the most generally useful, especially for thin and difficult sections. Paraffin may be used simply as an embedding or supporting medium, and this requires but little explanation. The object is fixed and cleared by any of the usual methods, as explained at length in the earlier papers of this series, and the melted paraffin is run round the tissue into a suitable mould. Of course, the results are but rough and ready, and the sections are only satisfactory in a few cases. The proper method is that known as the *infiltration* method, where the tissues are thoroughly permeated with paraffin.

A good microtome is necessary, and the knife must be in perfect condition, but on all these essentials stress has already been laid. *Thorough* infiltration is, however, of no less importance, and this must always be borne in mind. Paraffin is best bought from the dealers, and must be of the proper melting point. For general use it varies between 43° and 58° C. Thin or hard sections require a harder paraffin than thick sections, whilst the temperature of the room also modifies the paraffin. In fact, by adjustment of the temperature of the room in the winter months much can be done to bring refractory sections into a satisfactory state. Generally speaking, with a room at about 16° C., paraffin of 45° C., will be advisable for moderately thin sections, whilst for very thin sections, say, of less than 5μ, a harder paraffin of 48° to 50° C. or more may be necessary. Serial sections generally require paraffin with a melting point of 52° C. or more, up to 58° C. Paraffin must never be melted over an open light, or on a very hot plate, but must always be melted over a water-bath, otherwise the melting point will rise considerably, and it is not generally known that frequently melted paraffin has the same tendency to increase in hardness. It is not advisable to mix two paraffins of different melting points to get an intermediate paraffin, as is recommended by some writers, as it is better to buy paraffin of the requisite melting point, and the control of the temperature of the room, where practicable, will be found of much service. Paraffin of about 50° C. melting point is perhaps the most generally useful.

It is unnecessary to go into the preliminary stages of fixation, dehydration, and clearing, as these have already been dealt with. The fixative must be very thoroughly washed out, especially osmic acid and chromic salts, whilst acetic alcohol must be removed with methylated spirits.

The final clearing agent, however, is not a matter of indifference, apart from the peculiarities of various clearing agents alluded to in previous papers of this series. Turpentine and chloroform mix well with paraffin, but the former is apt to damage delicate tissues, and the latter penetrates badly. Benzole and xylol are excellent solvents for paraffin, but the best clearing agent of all is cedar-oil, which penetrates well, does not make the object brittle, and mixes well with paraffin. Any trace of alcohol must be scrupulously avoided, as it does not mix with paraffin.

Moulds of some kind are necessary, and these may be small stiff paper boxes, such as are easily made; trays made of paper or cardboard; "thimbles" made by wrapping a piece of notepaper round the end of a cork and leaving the requisite depth projecting, or adjustable moulds made of type-metal. These last are very convenient. They are formed of two L-shaped pieces of type-metal with rectangular edges, and lie by their own weight upon a plate of metal or glass, the surfaces in contact being slightly glycerined beforehand. For small objects, a watch-glass is the most convenient of all, as it enables accurate orientation to be readily made, and after embedding the object is easily cut out in a rectangular block by means of a slightly-warmed pen-knife or scalpel.

The paraffin should be cut into as rectangular a block as possible, and the object should lie near the surface. For serial sections the upper side must be truly parallel, otherwise the ribbon of sections will not run true. When the blocks are affixed to wooden holders it is advisable to give them a broad base.

(*To be continued.*)

Royal Microscopical Society.

April 15, Mr. Conrad Beck, Vice-President, in the chair. The donation of an old microscope from Mr. Wynne E. Baxter, was announced. It was made by Shuttleworth, after Benjamin Martin's model, and the date was probably about 1786. The instrument will be a valuable addition to the Society's unique collection, as it forms a link between Benjamin Martin, who died in 1782, and Jones' "Most Improved" model, in 1797. Messrs. W. Watson and Sons exhibited a new form of museum microscope, designed by Mr. C. O. Waterhouse, of the Natural History Museum, at South Kensington. It is entirely enclosed in a glass case, excepting the eye piece, and all parts are secured against interference or removal by the public. A drum holding twelve mounted objects can be rotated from outside the case. Mr. J. Inderwick Pigg exhibited a specimen of Webb's microscopic writing, the Lord's Prayer, containing 227 letters, written with a diamond in the space of $\frac{1}{2370000}$ sq. inch, which is the ratio of 15 bibles to the square inch. The size of the space occupied by the writing was $\frac{1}{447}$ inch by $\frac{1}{531}$ inch, and the ratio of letters to the square inch was 53,880,000. A $\frac{1}{12}$ inch objective was necessary to decipher the writing. In reply to an enquiry by the Chairman, Mr. C. L. Curties informed the meeting that Mr. Webb broke up the machine with which he did his writing before he died. Mr. F. Shillington Scales read a paper by Mr. James Strachan "On Dendritic Growths of Oxide of Copper on Paper." The subject was illustrated by a large number of examples exhibited under microscopes, by lantern slides shown on the screen, and by various other objects. Mr. Strachan verified previous investigations showing that these dendrites originated in minute particles of copper, and that their branching was due to the direction of the fibres in the

paper, and showed further that they were not peculiar to any class of fibre, and that the time required for their growth might be as short as twelve months. He brought forward much evidence bearing on the conditions which modified their growth, and made various suggestions with regard to the exact chemical processes involved. Mr. F. Enock gave an exhibition of lantern slides taken by the Sanger-Shepherd three-colour process "On Nature's Protection of Insect Life," and described the method he employed in their production.

Quekett Club Journal.

The half-yearly volume of the Quekett Club Journal, just issued, contains a paper by Mr. J. Murray, on *Philodina macrostyla*, one of the Bdelloid rotifers, and its allies, illustrated by two plates; a note by Mr. E. M. Nelson, on "Some Hairs upon the Proboscis of the Blow-fly"; a paper by Mr. T. B. Rosseter, on *Hymenolepsis fragilis*, with a description of this little-known tape-worm, and a plate; a paper by Mr. W. Wesché, on "The Male Genitalia of the Cock-roach, *Periplaneta orientalis*, and their homology with the Genitalia in Diptera," illustrated by two plates; and Mr. E. J. Spitta's Presidential Address on "The Photography of very Translucent Diatoms at High Magnifications." In this, the author deals with the "fog" which appears in the image and subsequent photograph of such translucent diatoms, and recommends the taking of a first negative upon a rapid, instead of the usual slow, plate, the printing of this by contact on a second fast plate, which is then developed as a second negative, though it is really, of course, a well-exposed and developed intermediate positive, though still showing fog, and the transference of this second plate to a slow plate, which thus become the real second negative, and from which the final prints are taken. The rest of the Journal contains reports of the Proceedings of the Club, the Annual Report, List of Members, etc.

Collecting and Preserving Medusae.

Mr. E. T. Broune gives an account in the Transactions of the Linnean Society of the methods which he has used for some years in collecting and preserving medusæ, and these methods have been summarised in the Journal of the Royal Microscopical Society. A small, flat hand-made net of bolting silk is useful for catching medusæ swimming at the surface. For towing nets the following sample is described. It has a circular mouth 17 inches in diameter, and the net is about five feet in length, gradually tapering down to 3¼ inches in diameter, which is the diameter of the zinc can attached to the end of the net. The nets are made of bolting silk; three nets form a series with 30, 50, and 70 threads respectively to the inch.

The speed of towing the net is important, and the speed is about right when the line can be comfortably held on one finger; this amounts to about a 3-lb. pull.

When the net is taken on board, the contents of the can should be poured into one or more glass vessels. The medusæ are then picked out and placed for half-an-hour or more in another vessel until they have recovered from the shock. If they lie heaped up at the bottom of the vessel they should be stirred up with a glass rod. The medusæ are quickly fixed and preserved by means of formalin (5-10 per cent.), but in order to do this successfully they must be kept in motion by stirring up with a glass rod while the formalin is slowly poured in. After a few hours they are transferred to 10 per cent. formalin, changed once before sealing up the bottle.

To obtain medusæ in a good state of expansion it is necessary to use an anæsthetic. Add about 3 c.cm. of 1 per cent. cocaine for every 100 c.cm. of sea-water, stirring gently the while with a glass rod. If in from 10-15 minutes the tentacles are expanded, and do not contract when touched with a glass rod, no more cocaine need be added, but if still active the process must be repeated. When the medusæ are anæsthetised, stir them round gently, and add the formalin, still stirring the while. Specimens must not be left too long in a cocaine solution, as it has a softening action.

For Scyphomedusæ the addition of chromic acid is of advantage. The author uses one vol. 5 per cent. chromic acid and 9 vols. 10 per cent. formalin. After soaking for several days in the chromic-formalin solution, to which a little strong formalin is added daily, the specimen is transferred to 10 per cent. formalin for permanent preservation.

Microscopical Material.

By the kindness of Mr. J. Strachan, of Ballyclare, I am able to supply to any who care to apply to me for them, specimens of dendritic crystals in paper. A paper by Mr. Strachan was read at the meeting of the Royal Microscopical Society, held on April 15, which is this month summarised in the report of the meeting in these columns, but these dendritic forms are probably familiar to many readers. They were formerly put into the vegetable kingdom and given botanical names such as "Conferva dendritica," but their metallic origin is now conclusively established, both by chemical and other tests, and their mode of formation explained. They can be mounted dry, or in Canada balsam. Applications must be accompanied by a stamped, addressed envelope, and by the coupon to be found in the advertisement columns of this issue of "KNOWLEDGE."

Notes and Queries.

A. H. J. (*Stoke-on-Trent*).—I am not familiar with more than the commonest species of Spirogyra, as I am only interested in them from the biological standpoint, but are you sure that the excrescences referred to are not attempts at conjugation, say, of the lateral rather than of the scalariform type? Of course, you may be quite familiar with this method of conjugation, and have satisfied yourself that this is not so.

W. H. M. (*Tunbridge Wells*).—The Traviss expanding stop is made and supplied by Swift, Watson, and other makers at about 7s. 6d. It can be fitted into the swing-out ring lying beneath the condenser, and it is immaterial whether the mount of the condenser is of the sub-stage or under-stage variety, or whether the condenser is the ordinary Abbe or the achromatic type, but, of course, the ring must be of the usual size. It would be best to get it from the maker of your condenser. The Traviss expanding stop obviates the necessity of having a variety of stops for different powered and apertured objectives, and enables exact adjustment relative to the aperture to be made. In this connection note also the article in last month's "KNOWLEDGE" on dark-ground illumination for high powers.

H. P. (*Boscombe*).—It is only necessary to break the peat into small bits and then to boil for an hour or two in a large test tube with a fairly strong solution of carbonate of soda until the peat has quite disintegrated. The carbonate of soda is then washed away and the diatoms removed. They may then be boiled for a short time with nitric acid, which is afterwards washed away with repeated changes of water.

[Communications and inquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge. Correspondents are requested not to send specimens to be named.]

XUM

The Face of the Sky for June.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 3.51 and sets at 8.4; on the 30th he rises at 3.48 and sets at 8.18.

Summer commences on the 21st, when the Sun enters the sign of Cancer at 8 p.m.; this is the longest day, the Sun being $16^h\ 34^m$ above the horizon. The equation of time is negligible on the 14th and 15th, hence these are convenient days for adjusting sundials, as only the correction for longitude is needed. Sunspots and prominences continue to be fairly numerous, though they are usually of the normal type.

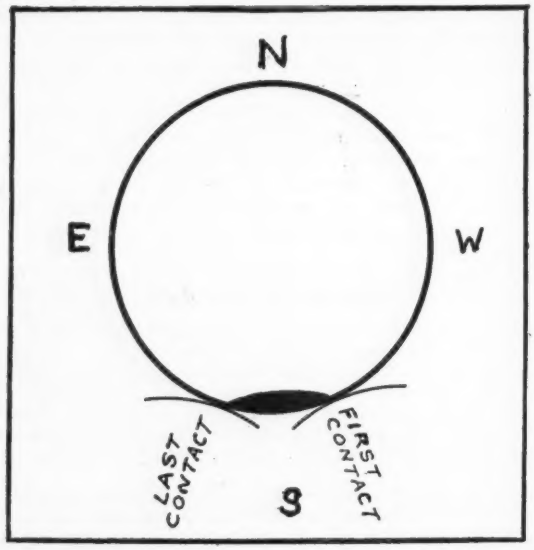
There will be an annular eclipse of the Sun on the 28th, visible at Greenwich as a Partial Eclipse, Magnitude (Sun's diameter = 1) 0·065.

		h	m	
Begins	June 28,	5	13·9	Greenwich Mean Time (p.m.).
Greatest Phase	28,	5	38·3	
Ends	28,	6	1·9	

Angle, from North point of { first contact, 205° / last contact, 163° } towards the East.

Angle, from Vertex of { first contact, 163° / last contact, 122° }

The appended diagram shows the amount of the disc eclipsed.



The position of the Sun's axis, equator, and heliographic longitude of the centre of the disc is shown in the following table:—

Date.	Axis inclined from N. point.	Centre of Disc S. or N. of Sun's Equator.	Heliographic Longitude of Centre of Disc.
May 30 ..	16° 11′W	0° 44′S	181° 52′
June 4 ..	14° 18′W	0° 8′S	115° 43′
,, 9 ..	12° 18′W	0° 28′N	49° 32′
,, 14 ..	10° 12′W	1° 4′N	343° 21′
,, 19 ..	8° 2′W	1° 40′N	277° 10′
,, 24 ..	5° 48′W	2° 16′N	210° 59′
,, 29 ..	3° 32′W	2° 48′N	144° 48′

THE MOON:—

Date.	Phases.	H. M.
June 7..	☽ First Quarter	4 56 a.m.
,, 14..	○ Full Moon	1 55 p.m.
,, 21..	☾ Last Quarter	5 26 a.m.
,, 28..	● New Moon	4 31 p.m.

Date.	Phases.	H. M.
June 5..	Apogee	0 30 a.m.
,, 16..	Perigee	9 54 p.m.

THE PLANETS.—Mercury (June 1, R.A. $6^h\ 14^m$; Dec. N. 25° 29′; June 30, R.A. $7^h\ 4^m$; Dec. N. 18° 44′) is an evening star in Gemini, and throughout the month is favourably placed for observation. The planet is at greatest Easterly elongation of 23° 58′ on the 8th, when he sets at 10.7 p.m., or two hours after the Sun. There is an interesting conjunction of the planet with Mars on the 7th at 4.24 p.m., Mercury being only 0° 19′ N., and as their relative motion is small it will be possible to view both planets in the same field after sunset, when a comparison of the discs can be made. The apparent diameters of Mercury and Mars on this date are 8″ and 3″·7 respectively, whilst 0·4 of the disc of Mercury is illuminated.

Venus (June 1, R.A. $7^h\ 23^m$; Dec. N. 24° 41′. June 30, R.A. $7^h\ 12^m$; Dec. N. 19° 40′) is an evening star in Gemini. The planet is a brilliant object in the Western portion of the evening sky during the earlier part of the month. Towards the end of the month, however, the planet sets shortly after the Sun, and is lost in the solar rays. The apparent diameter of the planet on the 14th is 47″, when only 0·13 of the disc is illuminated, hence the appearance in the telescope is that of the thin crescent moon.

Mars (June 1, R.A. $6^h\ 28^m$; Dec. N. 24° 23′. June 30, R.A. $7^h\ 49^m$; Dec. N. 22° 15′) is an evening star in Taurus, practically out of range for useful observation on account of his small apparent diameter. The planet is in conjunction with Mercury on the 7th (see above).

Jupiter (June 1, R.A. $8^h\ 47^m$; Dec. N. 18° 43′. June 30, R.A. $9^h\ 8^m$; Dec. N. 17° 17′) is still a conspicuous object in the evening sky looking West at sunset. The planet is situated in Cancer, and moving in a direction towards Regulus. The equatorial diameter of the planet is 32″, whilst the polar diameter is 2″ smaller. The Moon appears near the planet on the evening of the 3rd. On the 1st the planet sets at 11.53 p.m., and on the 30th at 10.11 p.m.

Saturn (June 1, R.A. $0^h\ 33^m$; Dec. N. 1° 9′. June 30, R.A. $0^h\ 40^m$; Dec. N. 1° 42′) is a morning star in Pisces rising about 1 a.m. near the middle of the month.

Uranus (June 15, R.A. $19^h\ 9^m$; Dec. S. 22° 56′) is situated in Sagittarius. The planet rises about 9.30 p.m. near the middle of the month, and is on the meridian about 1 a.m. He can just be discerned with the naked eye about 2° South of the star π Sagittarii.

Neptune (June 15, R.A. $7^h\ 0^m$; Dec. N. 21° 59′) is out of range being lost in the Sun's rays, as early next month he is in conjunction with the Sun.

METEOR SHOWERS:—

Date.	Radiant. R.A.	Radiant. Dec.	Name.	Characteristics.
	h. m.			
June—July. .	16 48	−21°	α Scorpiids	Fireballs.
June 13 ..	20 40	+61°	α Cepheids	Streaks, swift.

KNOWLEDGE & ILLUSTRATED SCIENTIFIC NEWS.

Literary Supplement.

REVIEWS OF BOOKS.

ASTRONOMY.

Is Mars Habitable? by Alfred Russel Wallace (London: Macmillan, 1907, xii. and 110; 2s. 6d.).—Readers of "Man's Place in the Universe," in which Dr. Wallace strove to insist that human life is not possible except on the earth, will feel no surprise that he should examine with a critical eye the different conclusions of Professor Lowell in his book on "Mars and its Canals." The present publication surpasses the limits of a simple review and bears testimony to its author's appreciation of the strength of the case he had to meet. It gives in considerable detail the history of the controversy as to the origin of the so-called "canals," the insufficiency of the Martian atmosphere and water supply to support life as we know it, and the vexed question as to the mean temperature and consequent probable climatic conditions of the planet which is the best placed for observation from the earth, and the only one whose surface can be distinctly seen. Dr. Wallace cites against Professor Lowell the physical proof given by Dr. Johnstone Stoney of the non-existence of water-vapour on Mars, and, in reply to a mathematical investigation given by Lowell in the Philosophical Magazine, discounts his conclusion as to a temperate climate by the assertion that Lowell has ignored the great "blanket" effect of a dense atmosphere, an effect which the dry and sparse atmosphere of Mars would produce only in a very small degree. Dr. Wallace's suggestion that the "oases" at the intersection of "canals" were caused by bombardment of Mars by large meteors and that the "canals" are cracks caused by the several impacts, is very interesting, and on the face of it at least as plausible as Lowell's stupendous irrigation scheme, and while the latter gives very unconvincing figures to diminish the inherent improbability of his suggestion, Dr. Wallace is anxious to have the possibility of his demonstrated, or, at any rate, tested, by actual experiment with clay balls and shot. The presentment of the case against the habitability of Mars is excellent and the conclusion reached by Dr. Wallace almost irresistible. To the large public whose interest in Mars has been periodically stirred during the last twenty years this book should appeal very strongly.

Heliographic Positions of Sun-Spots Observed at Hamilton College, from 1860 to 1870, by Dr. C. H. F. Peters. Edited by Edwin B. Frost (Director of Yerkes Observatory).—The Carnegie Institution, by rendering these old observations available, has provided this branch of solar research with a quantity of homogeneous material covering a period which began before the end of Carrington's work, and marched for many years parallel with the early part of the Kew period, and, what is of still greater importance, covered the few months between these two while the Kew photoheliograph was in an experimental stage. Spörer's observations at Anclam also cover the same gap, but as the record at no single station can hope to be complete this does not greatly discount the value of Dr. Peters' work. The mass of figures in the (nearly 200) pages of the publication is of no general interest, but it is as well to mention that the observations were made on the sun's image projected on a screen, everything measurable on the disc being notd and a micrometer employed whenever necessary.

BOTANY.

Plant Breeding, by Hugo de Vries (London: Kegan Paul, 1907; 7s. 6d. net).—Professor De Vries' theory of the origin of species is now generally known as the mutation theory, and is briefly indicated as follows in the book under consideration:—"Species are derived from other species by means of small sudden changes which, in some instances, may be scarcely perceptible to the inexperienced eye. From their first appearance they are uniform and constant, when propagated by seed; they are not connected with the parent species by intermediates, and have no period of slow development before they reach the full display of their characters." The present book, as the subtitle, "Comments on the Experiments of Nilsson and Burbank," indicates, is a review of the work done by these well-known "plant breeders." A general historical review of the pioneers in this work is given with marked impartiality. Nilsson's work was mostly devoted to the improvement of those cereals commonly cultivated in Sweden, and his important discovery was based on the principle that elementary species, or mutants, furnished the true material for selection, and that such were found to be sufficiently numerous and varied to satisfy all demands. Burbank's success appears to have also depended to a large extent on his unconscious selection of mutants for his experiments. Respecting Burbank's spineless cactus, the author guardedly states that a spineless, edible cactus would be a welcome addition to the agriculture of the semi-arid West, if it could be cultivated without irrigation on the same plains where the spiny forms now grow. The book contains much valuable information on matters bearing on De Vries' view as to the origin of species, and is a valuable supplement to his more pretentious work dealing with the same subject. The numerous illustrations are excellent.

Introduction to Plant Ecology, by the Rev. Professor Henslow, M.A. (London: E. Stanford; 2s. 6d.).—Ecology, or the study of plants in their native homes, is now beginning to be recognised as the best method by which a clear insight can be gained as to the origin of the numerous kinds of plants at present existing on our globe. On this subject Professor Henslow proves to be an apt guide; in fact, he has been advocating the leading principles of ecology in various books and papers dating from 1888. What too frequently passes for ecology is a series of statements indicating the characteristic plants inhabiting moorlands, marshes, uplands, &c. The object of the book under consideration is to indicate the methods by which a clear understanding can be gained as to why different kinds of plants occur in different situations and under different conditions. To achieve this object emphasis is placed on the necessity of an investigation of the morphological and physiological characters of plants, also on experimental work for the purpose of noting changes induced by growing plants under conditions different to those to which they are accustomed.

CHEMISTRY.

A Course of Practical Organic Chemistry, by T. S. Price, D.Sc., F.I.C., and D. T. Twiss, M.Sc., A.I.C. (London: Longmans, Green, and Co.; pp. xiii. and 239; 3s. 6d.).—This book is practical in more senses than one. Though primarily intended to cover the ground prescribed by the recent revision of the Board of Education Syllabus, which it does very efficiently, it will also be found an excellent guide to the study of practical organic chemistry even by those who wish to avoid the converging lines of an examination. It includes the preparation and description of the properties and reactions of typical organic compounds, the methods of elementary analysis, the determination of physico-chemical constants, such as the molecular weight, and a novel scheme for the systematic qualitative analysis of the more common organic substances. The book is well arranged and well printed, and is illustrated with the necessary diagrams.

Thermo-Chemistry (Text-Books of Physical Chemistry) by Prof. J. Thomsen. Translated from the Danish by Katharine A. Burke, B.Sc. (London: Longmans, Green and Co.; pp. xv. and 495; price 9s.).—The measurement of the changes of temperature which take place in the course of chemical reactions between different substances was one

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of the earliest directions in which attempts were made to apply physical methods to chemistry, and the gradual accumulation of an immense number of determinations has supplied the data for theoretical deductions and enabled thermo-chemistry to take its place as a separate branch of the science. No better introduction to it could be desired than is given in this text-book by Professor Thomsen. A full description is given of the chief experimental calorimetric methods in use, and the results, which are noteworthy as having all been obtained by the author himself, are classified and discussed in sixteen chapters grouped under the four headings: (1) Formation and Properties of Aqueous Solutions; (2) Compounds of Non-Metals; (3) Compounds of Metals with Non-Metals, and (4) Organic Substances. With regard to the theoretical part, it is pointed out by the translator that as the conception of ionization has been introduced into chemistry since the appearance of the last volume of the Danish edition in 1886, the student may, if he wishes, interpret the author's results, so as to accord with the more modern view. The work of translation has been admirably done, and, like all the other text-books in this series, the book is clearly printed and well arranged.

The Complete School Chemistry, by F. M. Oldham, B.A. (London: Methuen, 1908; pp. viii. and 416; 4s. 6d.).—So plentiful have become the elementary text-books on chemistry, each more or less permeated by the suggestion of pending examination, and so well, as a rule, do they all answer their primary purpose, that in giving the preference to one above another it is necessary to take into account to what extent it does not give direct answers to examination questions. The present book may be recommended as a successful attempt to combine the utilitarian with the scientific point of view. The title "Complete" is perhaps too suggestive of a subject that may be dropped as soon as it has served its purpose of scoring marks, but the student who has mastered this book will hardly wish, we think, to leave chemistry behind with his school days. An excellent plan has been adopted in the arrangement, each chapter beginning with a series of experiments, so that the interest of the student is roused before he comes to the theory illustrated by the experiments.

EVOLUTION.

No Struggle for Existence; No Natural Selection, by G. Paulin (Edinburgh: T. and T. Clark, 1908; pp. xxi. and 261; price 5s.).—From the extreme assurance displayed with regard to the truth of his own views, we inferred on first reading this volume that the author must be a very young man, and, therefore, entitled to tender treatment. It appears, however, from a statement in the preface that he is really of more than mature age, and thus debarred from any claim to consideration on the score of youth. For this we are distinctly sorry, as we hoped that statements like the one on page 79 as to the young of all equine animals being striped might be excused on the ground of the author being still in *statu pupillari*. His claim to have refuted two of the main foundations of Darwinism rests apparently on two grounds. The first of these is the alleged absence of any connecting links among extinct forms; and if the occurrence of types "between fishes and the first bird forms and the first mammals" is essential to the theory, it has to be confessed that none is yet known to science—nor, for that matter, is at all likely to be. The author's second point is that among certain groups of mammals the superfluous offspring are killed off, not by the struggle for existence, but by their own male parents. Whether this be really the case we have very considerable doubt, but even if true, it affects only what is practically an infinitesimal portion of the animal kingdom, and cannot, therefore, in any way be regarded as fatal to the Darwinian hypothesis. It may be added that our confidence in the author is not increased by the candid confession that while the volume was in the press he changed from being a "life-long evolutionist" to—he alone knows best!

The World Machine — The First Phase — The Cosmic Mechanism, by Carl Snyder; illustrated (Longmans: 1907; xvi. and 488; price 9s. net).—This work claims to be the first portion of a trilogy, those in preparation being "The Mechanism of Life," and "The Social Mechanism," and the basic idea appears to be to trace the inevitable evolution of everything on a purely mechanical theory. This naturally involves considerable difficulty, and the fact that the chapters, each of which is a literary essay on some link in the author's preconceived chain of evolution, do seem to hang together with considerable plausibility, is strong testimony to his powers of analysis, and also to his ingenuity. Mr. Snyder does not set out as an historian, to give in chronological order the various steps by which our knowledge of the universe has increased from prehistoric times to the present day, giving due emphasis only to epoch-making discoveries. Strict adherence to this would mar the symmetry of his chain, so we need not be surprised to find a want of agreement here and there between his leading personages and those ordinarily held in honour among astronomers, not only in relative importance, but occasionally even in identity. History, however, is not an exact science, and we need not cavil if Mr. Snyder's conclusions fall short of the standard of the multiplication table. It must be confessed that his case is by no means proved, even by his own evidence, with sufficient clearness to undermine the faith of anyone who clings to what are sometimes called "the old shibboleths," in relation to a first cause; and such need not refrain from reading the two promised works when they appear. Mr. Snyder is first a writer of trenchant prose. His ideas, when they bear the impress of originality, are not so extravagantly speculative as might be expected. Whole chapters of the work are full of interesting, well-arranged and well-expressed fact, in respect of work done by successive investigators, and the conclusions they themselves have drawn. But we must confess to a strong suspicion that the author's literary gift is far in advance of his scientific knowledge, and that even his judgment is inferior to his language. For instance, in characteristic American fashion, he does not fail to cast scornful epithets at Airy, in connection with the discovery of Neptune, ignoring the lion's share of responsibility for delay that must for ever rest with Adams himself. It seems as if Mr. Snyder had not read a plain, unvarnished tale of the facts, but had adopted someone else's views wholesale, and if that be the case in so comparatively recent a question as the discovery of Neptune, it may safely be inferred that he has not delved deeply into original authorities for more ancient astronomy. Not that we blame him for that; as otherwise the book could hardly have been written at all. Where, however, we cannot refrain from criticism, is in such carelessness in regard to statements of fact, as is shown by the statement anent the minor planets. "The largest was the third in order of discovery—Vesta." Surely, every astronomer, and many people besides, could correct two inaccuracies in that single line, inasmuch as Vesta is neither the largest of the asteroids, nor was it the third discovered. In the later chapters, relating to the structure and development of the universe, the author's powers of speculation have more legitimate scope, though we venture to think few will agree with his claim that some future generation will certainly be able to forecast the weather five hundred years in advance. It is doubtful if anybody would even try to do such a thing unless the evolution of science succeeds in abolishing the death rate. The book must be read to be appreciated, and it is a book that can be taken up and read, a chapter at a time, without loss of interest. We fear that the word "Illustrated," on the title-page is misleading to modern ideas. There are no plates, but a very few diagrams in the text, of a geometrical character.

GEOLOGY.

Modern Lithology; Illustrated and Defined, by Ernest Howard Adye (Edinburgh: W. and A. K. Johnston, Ltd., 1907; 10s. net).—This book illustrates the great advance which has taken place in recent years in the study of lithology. The illustrations are most valuable. No less than 65 sections of rocks are illustrated in colour, as seen under the microscope, some being from the author's brush, taken through the camera lucida. Many are in consequence brightly and even vividly coloured. Next to the examination of the specimens themselves, nothing can be better than

their mode of representation here. There is a useful glossary, and the brief description of each rock is admirable and to the point. Every student should possess a copy, and as a somewhat new departure, we should like to see it in every public library.

Neolithic Dew-Ponds and Cattle-Ways, by A. J. Hubbard, M.D., and G. Hubbard, F.S.A., F.R.I.B.A. (London: Longmans, Green and Co., 1907; 2nd edition; 4s. 6d. net).—In the second edition of this work, we find additional chapters, including one on "Dew-pond" experiments. In these the simple structure of the dew-pond, as previously shown, and as repeated herein, has been departed from, but details are lacking which might tend to be of value, although reference is made to other experiments not recorded. The chief experimental pond, which was on a low-lying site, was given a 4-inch concrete bottom, and was covered with pitch, and then sand. As a non-conducting material, mica-blocks were laid next, and these were covered with asphalte. A certain amount of success resulted, but it was indecisive, and we trust the authors will continue their experiments. Of course, the expense of such a pond is great, and it is doubtful in consequence, supposing the experiment were successful, if it could ever be widely adopted. The book contains a short chapter on the Devil's Dyke, near Brighton. We must enter a strong protest against the statement that this "is obviously artificial," although this statement is somewhat modified later on. The Dyke is a natural geological phenomenon. Unfortunately, the authors seem to see in everything they contemplate neolithic cattle-ways or ponds, and their conclusions are too dogmatic, and lack scientific caution. The illustrations are excellent, although perhaps in these there is somewhat too much in the way of human figures.

The Shaping of Lindsey-by-the-Trent, by P. M. Burton, F.G.S., F.L.S. (London: A. Brown and Sons, 1907; pp. 59; price not stated).—The author's object is to trace the origin of the Lindsey landscape, and he adduces evidence to show the shifting of the courses of the Trent and Witham. To the former, the author attributes the present configuration of the landscape for the greater part. The book is a study of river-action, and contains much evidence in a small space. The conclusion arrived at is the existence of four former islands instead of two as now, and these are called the Isle of the Chalk, the Isle of the Oolites, the Isle of the Keuper, and the Isle of Axholme. Much praise is due for the excellence of the illustrations, "The Aegir," at Gainsborough, October 11, 1904, being particularly good.

MATHEMATICS.

Geometry of the Conic, by Professors G. H. Bryan and R. H. Pinkerton (London: J. M. Dent, 1907; 3s. 6d.).—The names of the authors are a sufficient guarantee of the excellence to be expected here. This book has been written in the belief that a study of the simpler geometrical properties of the conic and the commoner curves which are met with in applications of mathematics, forms a valuable sequel to an ordinary school course in the geometry of rectilinear figures and circles, and in the tracing of graphs. Although our own leaning is toward the analytical side, we must admit that an acquaintance with as much of the geometry of the conic as is given here is much to be desired, and we commend this small text-book for its lucid and simple presentation of the subject. Various other curves are dealt with besides conics, such as catenaries, cycloids, equiangular spirals, etc.

Matriculation Graphs, by C. H. French, M.A., and G. Osborn, M.A. (London: University Tutorial Press, 1907; 1s.).—This book is prepared to meet the requirements of such elementary examinations as the London Matriculation. It is based on the somewhat more advanced text-book on Graphs, by the authors, and the work of preparing it has been carried out by Mr. F. Rosenberg. The explanations are very clear and accurate; and, indeed, it appears to be throughout a most satisfactory manual. At the same time we are strongly of opinion that Graphs, treated as a separate subject, is being largely overdone, and in the present cramped position of scientific teaching in schools it is a pity that time should be taken up with the useless accretions which inevitably gather round any subject as soon as it is treated as a separate one for examination purposes. All the important parts can be learned quite easily and quickly in a physical laboratory in direct dealing with experimental results; and we think that it is better that they should be so learned.

The Trisection of an Angle on Euclidean Principles, by W. H. Beech (London: 1907, Published by the Author; 1s. 6d. net).—Every mathematician periodically receives papers from angle trisectors. The fallacy in this paper lies in the statement in the proof, "but the angle HKD is a right angle (by construction)"; and it is clearly not so. In the particular case of the right angle, the author's construction would give the following angles: $29^\circ\ 49'\ 10''$, $29^\circ\ 49'\ 10\frac{1}{2}''$, and $30^\circ\ 21'\ 40''$, approximately. The author alludes in his preface to Mr. Frankland's statement in "The Story of Euclid," that it has in recent years been proved to be impossible to trisect an angle by means of ruler and compasses only, and says that such statements tend to suppress investigation; but there is really no better way of stifling investigation than that of pestering mathematicians with these obviously unsound methods and wasting their time in proving their fallacies. Many attempts have indeed been made at the problem, but few contain such glaring inaccuracies. Mathematicians have long ceased to consider an archaic method of solving the problem, when linkages and other methods afford such simple solutions of it.

METEOROLOGY.

The Harlow Moor Observatory, Harrogate. Annual Report and Results of Observations for the Year 1907, by Fred. J. Dixon, A.M.Inst.C.E., Meteorologist to the Harrogate Corporation (Harrogate, 1908; 30 pp. 8vo.).—This is apparently the first annual report by Mr. Dixon, although observations have been made at the Harlow Moor Observatory for some years. The report is one of the fullest which we have seen from a local observatory. Illustrations are given showing the exposure of the various instruments. Mr. Dixon evidently wants the observatory to be thoroughly up to date, as will be seen from the following paragraph:—"A complete Electric Lighting and Heating Installation has been introduced to replace the antiquated oil lamps and stoves previously in use; this has, indeed, been a great benefit to the observer, as an electric lamp is fitted in the night [thermometer] screen; a movable hand electric lamp is used for reading the sunshine recorders, and an electric kettle is provided for the melting of snow, ice, &c., which materially saves both time and annoyance, especially during the winter months." Nineteen tables of results are included in the report, one of which gives the rainfall for each day during 1907, and another gives the monthly rainfall in each of the 25 years, 1883-1907. Mr. Dixon compares the mean temperature for 1907 with that of the average of 35 years. We hope that in the next annual report he will give the monthly temperature in each of the 35 years. The table of "Miscellaneous Phenomena" reveals some curious features in the climate of Harrogate—if correct. For instance, heavy dews occurred on seven days in September, and none in any other month in the year. Hoar frost occurred in September, October, November, and December, but not in any of the earlier months of the year. No solar halos were observed. If the observer wishes to have a reliable record of the various phenomena he must keep a sharp look-out, so that nothing escapes his observations, otherwise his results are apt to be misleading.

NATURAL HISTORY.

Nature Studies by Night and Day, by F. C. Snell (London: T. Fisher Unwin, 1908, pp. 311; 5s.).—The author of this book has not attempted to present any startling discoveries to his readers, but rather to give in simple language and fascinating pictures the results of his rambles around the country-side and on the sea-shore. Those of our readers who are at all interested in natural history problems, etc., will find Mr. Snell both entertaining and instructive, and the pictures—which are very numerous—help to make the work pleasant reading. Another feature, which renders the

book handy for reference purposes is its index, extending over 7 pages; this, however, in a later edition might with advantage be looked to.

Animal Artizans and Other Studies of Birds and Beasts, by (the late) C. J. Cornish (London: Longmans, 1907; pp. xxxiv. and 274, illustrated; 6s. 6d. net).—The late Mr. Cornish attained a great, and, on the whole, well-deserved, reputation as a popular writer on natural history and sporting subjects and the pleasures of country life. The sporting and country life side of his subjects was that in which he was at his best, for it cannot be denied that in zoological matters he was apt to get out of his depth, or, at least, to dish up worn-out theories as up-to-date science. As we are unaware of the original date of publication of the article on moles, we cannot say whether the author was liable to the latter charge in the case of his reference to le Court's exploded theory of mole-hills, but it is quite certain that the passage ought not to have been reproduced in the present volume; and the need of revision of the proofs by a professed zoologist is noticeable in more than this place in order to make the work altogether trustworthy. In general, however, it may be said that this posthumous collection of essays and articles, most of which originally appeared in the *Spectator* and *Country Life*, contains a vast amount of interesting matter connected with the habits of animals—from bees to greyhounds—written in that charming style which gave the author so great an advantage over many of his competitors in the same line of literature. Of the many readers interested in natural history who have derived pleasure and instruction from his numerous writings, there are no doubt a large number who would like to learn something of the personality of the talented author. To these we may commend the excellent, if somewhat pathetic, memoir by his widow, which forms the introduction to this attractive volume.

The Trustees of the British Museum (Natural History) have issued two new illustrated handbooks, **A Guide to the Gallery of Fishes** (pp. 201; 1s.) and **A Guide to the Exhibited Series of Insects** (pp. 57; 1s.). The Guides under notice are compiled with considerable labour, and apart from their technical importance form very interesting and instructive reading. Special attention has been paid to the illustrations, each book being well supplied with pictures, while the one dealing with insects has a number of photographic reproductions printed as plates on art paper. Sir E. Ray Lankester remarks in the preface to the Guide to the Fishes Gallery, that it has been deemed necessary to have the exhibited specimens of the larger series of fishes painted, so as to give as far as possible, a true idea of the natural colours of the specimens. This task, which proved a very difficult one, is now completed, and the Director of the Museum is to be congratulated upon the successful result.

The Moths of the British Isles, by Richard South, F.E.S. (London: Warne and Co., 1907; pp. 343; price 7s. 6d. net).—This volume, which made its appearance at the close of 1907, is but one of many which have appeared on the same theme during the last few years, and among this number it will certainly be accorded a very high place, for it is a book of exceptional merit; and one in every way worthy of the high reputation which Mr. South holds among British lepidopterists. Intended to serve as an out-door companion, it is small in size, and embraces within its scope the families Sphingidæ to Noctuidæ, thus leaving material sufficient to fill another volume. Every stage in the life-history of all the species herein described is given, and these descriptions are supplemented by 670 most beautifully coloured figures, besides a number of plates in black and white. The brief introduction to the study of moths is admirable; while throughout the volume most valuable information is dispersed as to colour variations, habits, and distribution. It is, in short, a volume which must find a place in the library of every entomologist.

ORNITHOLOGY.

The Birds of Britain by J. Lewis Bonhote, M.A., F.Z.S., &c. (London: Black, 1907; 20s. net).—Whosoever to-day essays to write a book on British birds undertakes a task of no small magnitude, and this not so much because of the intrinsic difficulties of the subject, but rather because since the appearance of Howard Saunders' "Manual of British Birds" little has been left for later historians to record; at least, in so far as matters of geographical distribution and diagnostic characters are concerned. But it is not to be supposed that the subject of British birds has been exhausted. Far from it; books such as the wonderful manual just referred to are to be regarded as but the forerunners of what shall follow. The diagnostic work being now done for us, it remains for the present and future generations of workers to fill in the details and give us the life-histories in the fullest detail of the species regarded as entitled to the rank of British birds. That Mr. Bonhote realises this we gather from a perusal of the pages of his book. Herein, it would seem, he assumes that his readers are interested rather with the birds as they appear before them on Nature's stage, than with the question of what they do, and where they go when they leave it. The space at his disposal being limited, he has accorded the greatest possible prominence to records of habits, peculiarities of habitat, moulting, and so on. By this plan he has contrived to place on record much that he has himself observed, that would otherwise have been crowded out. Among the many things that have pleased us in this book, none have been more in accord with our views than his fearless condemnation of the relentless slaughter of those of our native birds which are commonly classed as "vermin" by the game-preserver and pisciculturists. The ignorance displayed in this atrocious crusade is appalling, and the selfishness indicated thereby is no less so. Mr. Bonhote gives many proofs of his intimate knowledge of his subject; whereof we can quote but one instance. This concerns the protective character of the plumage of the common snipe. When seeking concealment this bird, writes the author, "puts its beak down and its body and tail well in the air, and generally pressed up against some growing vegetation. In this position the two light dorsal stripes appear like blades of grass, and all trace of the contour and shape of the bird is lost." With regard to the drumming of the Jack Snipe we fancy we have caught the author napping! At any rate, he assures us that it "drums" in the same manner as the common snipe. As a matter of fact, this is scarcely correct, for while the drumming of the last-named is produced by mechanical means, the "drumming" of the Jack Snipe is of a totally different character, being vocal.

That the author writes with a first-hand knowledge of his subject, and with enthusiasm, is evident in every page. It is, therefore, a matter for regret that he did not exercise more care with the revision of his proof sheets, for looseness of style and faulty construction are at times painfully evident in these pages. But faults of this kind can easily be amended in the second edition, which is almost sure to be called for. By way of illustrations a number of coloured plates have been selected from Mr. Dresser's "Birds of Europe." Some of these are really charming, some are indifferent, and some are positively bad, not only as to colour, but also in the matter of draughtsmanship. Finally, the cover of the book is absolutely hideous, but for this the author can hardly be held responsible, and the same remark applies to the plates, which were selected by Mr. H. E. Dresser.

A Book of Birds, by W. P. Pycraft (London: Appleton, 1908; pp. viii. and 155, 6s. net).—It is distinctly satisfactory in a popular series (in this case, Appleton's Popular Natural History Books) to have a work on birds by one who has studied the subject from the anatomical as well as from the superficial aspect. In such a limited space it was impossible for the author to tell as much as he would no doubt have desired, and the marvel is how he has managed to convey such a large amount of information in such a small compass. Classification is, needless to say, thoroughly up to date, as is exemplified by placing the owls next the nightjars and the pigeons in juxtaposition with the plovers, although it is unfortunate that we are not told where the sand-grouse are to come. The coloured plates, although not of the highest class, are as good as we have any right to expect

for the price; and they may, perhaps, render the book specially attracting on account of their tendency to extra brilliance of colour. In all probability the book will have a large sale and run to a second edition, in which event the author will no doubt make a few alterations in style and various other details. He may, for instance, discover that the expression "study of ornithology" as used by him is tautological, and that Terra del Fuego is not the way to spell the name of a well-known island; while on mature consideration he may conclude that it is not well to call the bullfinch *Pyrrhula pyrrhula* and the partridge *Perdix cinerea*.

PHYSICS.

The Evolution of Forces, by Dr. Gustave Le Bon (London: International Scientific Series, Kegan Paul and Co., 1908, pp. 386; 5s.).—No more timely and no more interesting volume could be added to the International Scientific Series than that in which Dr. Le Bon elucidates that new theory of the disintegration of the atom of which he was one of the first protagonists. It was a theory which in England remains associated with the otherwise inexplicable emanations of radium, and the controversy which arose over them. It is a controversy of which the echoes have not yet died down. Lord Kelvin, for example, was not fully prepared to accept the belief that the energy which is manifested by the radioactivity of certain of the metals arose from the elementary constituents of the metals themselves, and suggested that these metals were able to derive energy from molecular forces with which they were surrounded. Other suggestions were made by M. Berthelot in France, and Sir William Crookes and other chemists in England, who were unwilling to part with the convenient theory of the integrity of the atom. But though the newer theories which regard the atom as a reservoir, but not an impregnable reservoir, of forces, still lack sufficient definition and coherence, it is not too much to say that the majority of scientific inquirers regard these theories as necessary to the explanation of phenomena. In Great Britain their development and examination is chiefly associated with the names of Dr. Larmor, Dr. J. J. Thomson, Sir Oliver Lodge, and Professors Rutherford and Soddy. But it must not be forgotten that perhaps the most brilliant speculations on the forces which constitute the atom, and on the consequences which follow on the acceptation of such a theoretical basis of matter and energy, are those of Dr. Gustave Le Bon. In the volume before us he states them with a clearness and a conviction that seem to be part of the language in which Dr. Le Bon customarily thinks. His reasoning is not an assemblage of mathematical symbols, which, as he caustically remarks, only too often mask the truth or cloak a fallacy, but is put in words that are intelligible to any person with an intelligent appreciation of the first principles of mechanics and natural science. He is careful to say that the basis of his theorem is suggested rather than demonstrated by his researches, and that the conclusive proof of its validity must be delayed for the result of further experiments by himself and others. That being granted there is little to criticise in the emphatic statement of the case, while there is much to admire in the consecutiveness and logic into which he links together phenomena that are best to be explained by modifying the laws of the conservation of matter and of energy. He is at pains to state broadly the clauses of the theory which he seeks to demonstrate, and we cannot do better than quote the first and the last of them:—"Matter hitherto deemed indestructible slowly vanishes by the dissociation of its component atoms," and "Energy is no more indestructible than the matter from which it emanates." Those are the two chief canons of the new Principia, and no more attractive or coherent statement of the associated facts which are explained by them has yet been written than Dr. Le Bon's "Evolution of Forces."

The Polarity of Matter, by Alex. Clark, M.A. (Edinburgh: Gall and Inglis, 1907; 3s. 6d. net).—While welcoming every fresh endeavour to throw additional light on the phenomena of Nature we must confess that we have not ourselves received any help from this book. Surely Mr. Clark will join with us in thinking that it is necessary first to become accurately acquainted with the facts before attempting to construct a theory round them. There are so many statements made here which seem to us (perhaps in our ignorance!) to be in conflict with fact that it is impossible for us to commend the book.

PHYSIOLOGY.

The Functions of Food in the Body. Does either bodily energy or bodily heat come from the food? By A. Rabagliati, M.A., M.D. (London: Elliot Stock; 1s. net).—Physiology teaches that food supplies the material necessary for bodily growth, and the repair of its waste products; this much Dr. Rabagliati concedes, but he does not agree with what is practically a universal belief, that food is also responsible for bodily energy and the generation of bodily heat. The author endeavours to convince us that the sole function of the food intake is to repair the waste which the internal mechanism and the external work of the body necessitates. He adds, "This waste is much less than is commonly supposed." Dr. Rabagliati leans to the opinion he has formed, that under ordinary conditions the elimination of such products as uric acid, urea, CO_2, &c., from the body, bears a greater proportion to the amount of food intake than it does to the total amount of work the body performs. This may be so. That the amount of food authoritatively laid down as necessary for the maintenance of bodily health and vigour is far in excess of actual requirements has been proved by Chittenden's experimental researches into the minimal proteid requirements of healthy men (Physiological Economy in Nutrition, 1905, London, Heinemann). We must conclude then, that owing to food surfeit, our waste products are greatly in excess of what they should be; that physical exertion cannot satisfactorily eliminate them, and that the waste material from the body cells circulating as toxins in the blood impede and retard organic function. By moderation in our food ingestion and its careful selection alone can we prevent with certainty the accumulation of toxic nitrogenous Katabolites in the system, the continuous presence of which eventually lead to disease. In other words, we must revert to the simple life. Dr. Rabagliati gives us in interesting, if not always convincing detail his reasons for doubting the soundness of the Physiological Law that food is responsible for the source of energy and heat of our bodies. He conceives that the body work is run by "vital energy, or bio-dynatic becoming bio-dynamic," and that foodstuffs are not the source. The origin of vital energy, or bio-dynamic, he does not pretend to know, but suggests that its ultimate source is not dissimilar to all other forms of energy or power, and that its immediate source is obtained from the illimitable stores of energy to be sought for in Nature. Bio-dynamic is, he avows, replenished during sleep, and that, if there is no digestive reason to the contrary, we should awake re-invigorated for our daily task in life by its agency. As regards the question whether bodily heat is generated by food, Dr. Rabagliati considers that human bio-dynamic is itself the possessor of inherent powers of heat; that any heat liberated during digestion is distinct and separate from the heat of vital energy, and that the warmth of the latter is alone sufficient and efficient for the upkeep of the normal temperature of the body; in fact, is responsible for life. If, owing to excess or faulty alimentation, extra heat is evolved, unduly raising the body temperature, then we take it the body becomes the recipient of one of those forms of auto-intoxication which are causative factors of disease. For a deeper insight into the author's ideas, the reader is referred to the brochure; we cannot but think that this little work, if studied as it deserves, will advance the cause of the amelioration of human suffering which is so largely dependent on ignorance of the uses and functions of food in the body.

SOCIOLOGY.

New Worlds for Old, by H. G. Wells (London: Constable and Co., 1908; 6s.).—The larger importance of Mr. H. G. Wells' summary of Socialistic aims and problems lies in the fact that in "New Worlds for Old" the problems are, for the first time, clearly stated. In a Socialistic state, who is, for example, to pursue historical research in the Bodleian, and who to go mackerel fishing in November? The question is put by Mr. Wells himself, and his volume is an ingenuous attempt to suggest if not an answer, then at least the lines of policy on which a Socialistic state would deal with such questions as they arose. For the first time a

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partisan of Socialism writes not for convinced hearers, but in that scientific spirit which, when formulating a theory, desires to elucidate not the things which tell in its favour, but those which may tell against it. So far Mr. Wells' most interesting book may be said to appeal to the intelligent public as a whole, and we believe that whoever reads his book, whether in agreement or in disagreement with it, cannot but arise from it with a clearer perception of the greatest social problems of the day. But "New Worlds for Old" has a specific interest to the student of science because it is written by a man who has the scientific mind and who consciously or unconsciously adopts a scientific terminology and method in the statement of his case. Take, for example, the following passage from the chapter in which Mr. Wells opposes the current objection that the present state of society cannot be arbitrarily dealt with because it is the product of social evolution: "Socialism would arrest the Revival of the Fittest. Species, it is said, change—and the student of the elements of science is too apt to conclude that this change is always ascent in the scale of being—by the killing off of the individuals out of harmony with the circumstances in which the species of living. This is not quite true. The truer statement is that species change because, allowing for chance and individual exceptions, only those individuals survive to reproduce themselves who are fairly well adjusted to the conditions of life; so that in each generation there is only a small proportion of births out of harmony with these conditions. This seems very like the previous proposition, but it differs in this, that the accent is shifted from the 'killing' to the suppression of births. That is the really important fact. In any case the believer in evolution holds that the qualities encouraged by the environment increase in the species and the qualities discouraged diminish. The qualities that have survival value are not always those which we human beings consider admirable. . . . Let the objector ask himself what sort of 'fittest' are surviving now? . . . . People with the instinct of acquisition float to the top . . . . and below . . . . the survival of a race of stunted toilers with great resisting power to infection, contagion, and fatigue, omnivorous as rats." That is a stimulating and forceful passage, and it discloses the essential difference between evolution where man, Nature's rebel, is concerned, and natural evolution. Socialism, as Mr. Wells conceives it, is a process of artificial mutation governed by intelligence, and the conception has a special appeal to scientific people as a class, because in the modern state they have everything to lose and nothing to gain by leaving social evolution to work itself out unhindered.

Sociological Papers, 1906; Vol. III. (London: 1907; Published for the Sociological Society by Macmillan and Co.; 10s. 6d. net).—The Sociological Society is a live society that attracts many distinguished men to read papers and to take part in the discussions thereon; these are all reprinted in its official journal, "Sociological Papers," the third volume of which appeared a short time ago. Discussion still takes place as to what sociology really comprises, and Mr. H. G. Wells was bold enough to dispute "not only that sociology is a science, but also that Herbert Spencer and Comte are to be exalted as the founders of a new and fruitful system of human enquiry." He considered that one main branch of the work of a sociological society should be: (1) To restore the dead bones of the past to a living participation in our lives, and (2) the creation and exhaustive criticism of Utopias, and to measure realities from the standpoint of idealisation. It is not surprising that his views did not receive much support from subsequent speakers. Professor Wenley discussed sociology as an academic subject, but admitted that "we have not been able to classify it in such a way as to make it rank, as a discipline, with the older subjects. It is still in the experimental stage as an academic factor," and he concluded by stating that "the demands sociology makes constitute probably one difficulty in the way of its introduction into an academic course; they are also the most powerful argument it is favour." In dealing with the biological foundations of sociology, Dr. Archdall Reid made several statements that led to adverse criticism. He said, "We reach thus two fundamental biological laws. The first law is that germplasm is very highly indifferent to the action of the environment, and therefore that children are seldom affected by the influences to which their parents are exposed. The second law is that germ-cells, and therefore the individuals that arise from them, vary spontaneously among themselves, just as the body cells vary, and for the same reason. It follows that we cannot improve races of plants and animals by improving the conditions under which they exist. Such a course benefits the individual, but results in racial degeneration. The race can be improved only by restricting parentage to the finest individuals." Professor J. Arthur Thomson illustrated the value and the risks of the sociological appeal to biology, thus: "Pre-occupation with a purely ideal might in relation to the human race result in consequences which were anything but advantageous socially." He argued that the chief value of the appeal to biology is three-fold: "(1) The analysis of biological factors operative in social sequences may serve to bring into stronger relief what is distinctively social. (2) The biological analysis may serve to show that certain features of social life have organismal main-springs, and become more intelligible when traced back to these. (3) The parallelism of the two sciences is such that biological conclusions and experiences may have great suggestive value to sociology, aiding in the discovery of sociological laws, and indicating practicable possibilities of social evolution. Biology used unduly as a support may pierce the sociological hand. Biological formulæ and ideals require to be socialised in their application to human affairs." Dr. J. Lionel Tayler lectured on the study of individuals (individuology), and their natural groupings (sociology); the root conception being the idea of the study of individuals on individual lines as being a necessary preliminary to the study of the grouping of individuals on social lines. A practicable eugenic suggestion by Dr. W. McDougall, led, like most of the other papers, to a lively and suggestive discussion. Deploring the fact that the population is not proportionately or sufficiently increased by the most desirable classes, he proposed that all civil servants of a certain grade should be paid annually a maximum of £500 for a bachelor, £600 when married, and £75 for every child that is under twenty-four years of age. Professor Geddes, speaking from the practical experience gained from his Outlook Tower in Edinburgh, advocated the formation of a civic museum for London, and pointed out that an institution of this sort, if carried out on broad lines, would be an important means of sociological and civic instruction. Other papers and discussions were those on the Russian Revolution, by Mr. G. de Wesselitsky; The Problem of the Unemployed, by Mr. W. H. Beveridge; and Methods of Investigation, by Mrs. Sidney Webb. A division of sociology not hitherto represented in the Society's publications was opened by a paper, by Mr. A. E. Crawley, on the Origin and Function of Religion. The short paper, which led to a long discussion, enunciated the main theme of the author's book, "The Tree of Life." "The religious impluse has for its first sociological function the affirmation and consecration of life . . . the first and last biological result of religion is to raise human nature to a higher power, a fuller life."

This short account of the year's activities of the Sociological Society proves that it is wide in its range of subjects, free in its discussions, and is dominated by no school of thought.

ZOOLOGY.

An Elementary Course of Practical Zoology, by T. J. and W. N. Parker, 2nd edition (London: Macmillan, 1908; pp. xii. and 624, illustrated; 10s. 6d.).—Eleven new illustrations and nearly twenty additional pages mark a decided increase in this edition over its predecessor of 1900. Among the improvements may be noticed the inclusion of a brief account of *Monocystis* as an example of a sporozoan parasite, and of *Nereis* for comparison with that of the ordinary worm. Since the volume has already established itself as an indispensable class-book, there can be no doubt of the favourable reception awaiting this improved new edition.

The Dancing Mouse; A Study in Animal Behaviour, by R. M. Yerkes (London: Macmillan and Co., 1907; pp. xxi. and 290; 5s. net).—With this volume we have to welcome the appearance of a new series of zoological works—the Animal Behaviour Series. Personally, we confess to a cordial and thorough dislike of the word "behaviour" in this sense; but as it is now very generally thus employed in America, and as there might be some difficulty in finding an alternative, we must make the best of it. Great thoroughness and a vast amount of original work seem to be the leading features of this volume, and if these, with a similar excellence of style, should also be found in those to follow, the success of the new series ought to be assured. The special subject of the present volume is the so-called Japanese, or Chinese, dancing or waltzing mice. These are a small, pied breed, apparently of the ordinary house-mouse, characterised by being stone-deaf when adult, and also in possessing certain visual peculiarities, as well as by immunity to rotatory giddiness. They appear to have been imported from China to Japan, where they are kept, not for their waltzing propensities (in which the size of their cages does not permit them to indulge), but for their agility in climbing and general cleverness. When allowed sufficient room, they constantly perform the rotatory performances from which they take their name, during which they revolve at high speed with their heads as an axis. Attempts have been made to account for this rotatory tendency by a supposed imperfection in the structure of the semi-circular canals of the ear; but, despite certain abnormalities in other parts of the ear, these appear to be non-existent. In the author's opinion, no adequate explanation of the physiological peculiarities of these mice "can be given in terms of the structure of the peripheral or the central nervous system, or of both, but that the structure of the entire organism will have to be taken into account." That a structural basis for these eccentric habits does exist, Dr. Yerkes is fully convinced; and he commends the solution of the problem on these lines as an interesting field for investigation.

The Vertebrate Fauna of North Wales, by H. E. Forrest (London: Witherby, 1907; pp. lxxiv. and 537, illustrated; price 17s. net).—The author and the numerous contributors by whom he has been assisted are to be heartily congratulated on the result of their labours; and in saying this it should be remembered that the work, as stated in the preface, is to a great extent a first attempt, as the fauna of a considerable portion of the area had never previously been worked out. The labour must, indeed, have been very great, and the thoroughness with which the task has been carried out is, therefore, worthy of unstinted praise. The volume opens with a historical account of the zoologists of North Wales, illustrated in many cases with portraits, and commencing with Giraldus in 1147. Then follows a well-written account of the physical features of the district, in connection with which mention may be made of the excellent map at the end of the volume. The routes of bird-migration next receive attention; this section being, perhaps, one of the most generally interesting in the whole work. Welsh names and their pronunciation are discussed in a couple of pages, and we then come to the systematic portion, commencing with mammals and ending with fishes, fossil forms being referred to in connection with their nearest relatives. The latter statement, perhaps, requires a slight qualification, since we find the wild boar placed, for no apparent reason, between the otter and the seal. We must also take exception to the statement on page 1 that the scientific names of the mammals are those in use at the British Museum (Nat. Hist.), since a walk through the galleries of that building will show that *Cervus tarandus* and *Rhinoceros tichorhinus* are not the designations there assigned respectively to the reindeer and the woolly rhinoceros. We also notice a discrepancy in the style of nomenclature employed respectively in the case of the mammals and the birds. In the former we have, for instance, such names as *Vulpes vulpes* and *Meles meles*; and this being so we ought to have *Coturnix coturnix* in place of *C. vulgaris* in the latter, and so on in many other cases. We may also take exception to the statement that the gwyniad, or "freshwater herring" (a name to which the author raises a needless objection), occurs elsewhere than in North Wales; for a visit to the Natural History Museum would in this case also have shown that the Lake District, Scottish, and Irish representatives of this fish are now regarded as distinct—whether racially or specifically being immaterial. These, however, are but minor blemishes to an otherwise excellent work.

Evolution of Mammalian Molar Teeth to and from the Tritubercular Type, by H. F. Osborn, edited by W. K. Gregory (London: Macmillan, 1907; pp. ix. and 250; 8s. 6d.).—Owing to attacks from several distinct quarters and on several sides, there was a decided danger that the "tritubercular theory" of tooth-formation might fall into discredit among zoologists and palæontologists. Professor Osborn, who, although not its author, has been the chief apostle of the doctrine, is, however, not a man to take attacks lying down, and in the present volume he has turned on his aggressors, and, in our opinion, vindicated the essential truth of trituberculism. Those of our readers who are not specialists in the matter of mammalian dentition may, perhaps, like to be informed that according to the tritubercular theory all the early mammals had molar teeth with three cusps on their crowns arranged in triangular fashion, and that from such a tricusped type all the complex patterns of tooth-structure to be met with among the higher forms are derived by the addition of extra cusps. It was assumed in the early days of the theory that the three primitive cusps must always serially correspond with one another, and one of the lines of attack was the demonstration that such is not invariably the case. Professor Osborn admits the force of the argument, but at the same time maintains that it is by no means incompatible with the truth of the doctrine, which rests upon a practically impregnable basis of palæontological evidence. In a short notice like the present, it is obviously impossible to review evidence of such a technical nature, and all that can be done is to recommend students to read the book itself; if they are not convinced we shall be surprised. Our one regret is that the author did not re-write the book, instead of making "resurrection-pie" out of a number of old articles on the subject.

The Animal Mind: A Text-Book of Comparative Psychology (Animal Behaviour Series), by Margaret F. Washburn (London: Macmillan and Co., 1908; pp. x. and 333; 7s.)—In welcoming this second volume of the Animal Behaviour Series we have, in the first place, to express our opinion as to the extreme difficulty of the task undertaken by the author, and the ability with which she has accomplished that task. From title-page to index the work is indeed nothing but a continuous chain of inductive reasoning; there being practically not a single section of the subject which can be dismissed by the quotation of solid trustworthy fact. Our one source of regret is that Miss Washburn has not seen her way to give a concise summary of the evidence, and the conclusions to be drawn therefrom, at the close of the volume, as this would have saved a vast amount of trouble in endeavouring to ascertain her real opinions on this abstruse and perplexing subject. Since, however, she states "that no one can prove the absence of consciousness in even the simplest forms of living beings," while she also considers it worth while to enquire in what respect the simplest mind of the simplest animal necessarily differs from our own consciousness, it may be inferred that Miss Washburn does not admit, at all events in its entirety, the automaton-theory of animal movements. The book is, however, eminently one from which enquirers should form their own opinions at first-hand, and not rely upon a reviewer.

The Nervous System of Vertebrates, by J. B. Johnston (London: Murray, 1907; pp. xx. and 370, illustrated; 15s. net).—A thoroughly comprehensive and up-to-date work on the nervous system, more especially from the physiological aspect, has for a long time been a distinct want. The

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want may be said to be fully supplied by the volume now before us, which is the result of the long, practical experience of a well-known and thorough-going American worker. As the author well remarks, the study of the nervous system demands an examination of the structure and mode of working of its constituent parts, combined with a consideration of its manifold relationships to other organs. These two factors receive full and adequate treatment throughout the volume, although the physiological side of the subject is discussed in greater detail than the anatomical, largely owing to the fact that the anatomy of the nervous system is more or less fully described in many text-books. As this system is essentially the telegraph of the body, it is manifest that to study it solely from the anatomical standpoint is as absurd as to examine telegraph apparatus without having any idea as to its use. "It must be insisted," writes the author, "that a knowledge of mere structure is of little value, and may be misleading, without a knowledge of function." The illustrations, for the most part diagrammatic, serve to explain the text; and the whole execution, style, and plan of the work may be said to be thoroughly satisfactory.

MISCELLANEOUS.

The Mind and the Brain by Alfred Binet (London: Kegan Paul, 1907; 5s.).— This book is the authorised translation of M. Binet's "L'Ame et le Corps." As will be noticed, the title has been altered, "because of their different annotation in English." The author, in his introduction, claims that his "book is a prolonged effort to establish a distinction between what is called mind and what is called matter." Descartes considered that the mind was an immaterial substance. Be that as it may, we are, since his day, cognisant of a distinction between mind and matter, and recognise it as an accepted philosophical truism. To elucidate the opposition between mind and matter, M. Binet would have us turn to Nature. By the study of Nature this "opposition," he considers, presents quite a different interpretation; he would have us discard the well-worn formulas and the method of concepts, as not capable of solving the difficulties. For the elaboration of his beliefs, as sought for in the realms of Nature, he would collect, examine, and analyse the various phenomena of mind and matter, and from their respective teachings differentiate the characteristics of each. This is the patient method of research that M. Binet has adopted; his findings tend to prove that between objects and our consciousness there exists a something else—our nervous system. Opposing interpretations deny the possibility of the nervous system acting as an intermediary with Nature, by reason of the latter's transformation before it is brought home to our consciousness. Thus, Binet propounds that knowledge of the outer world is subject to our sensations acting as an intermediary between the external object and ourselves. This doctrine is contrary to the conclusions of philosophers, such as M. Bergson. Book II. is taken up with the Definition of Mind, and covers the debateable ground as to whether sensation is a mental or physical result. The author considers it a physical impression, and if this is conceded, it must be capable of including a vast field of various phenomena. Attention is drawn to the duality of sensation, dependent as it is on something felt, plus the consciousness of that feeling. The something felt belongs to the domain of the physical, and its consciousness to the mental. We must refer our readers to the work itself for a further insight into M. Binet's philosophy. The translation of a work of erudition is always a difficult task, and it is not rendered the less so when the subject lends itself to abstruse phraseology; more's the pity, for otherwise this treatise might appeal to a larger section of the intellectual community.

A Proposal for a Simplified Calendar, by Alexander Philip (London: Kegan Paul, 1907; 1s.).—This small pamphlet is part of a proposed simplification of standards of measurement, put forward by its author in 1905, but the present pages are devoted to the calendar only. The guiding principle appears to be the modern craze for brain-saving rather than labour-saving devices, but it is open to question to how great an extent this is a good thing for the brain, since the exclusive use of pre-digested food has notoriously a weakening tendency on the average internal organisation. Briefly, Mr. Philip's idea is to divide each year into four quarters of 91 days or 13 weeks each, to regard the extra day in an ordinary year, and also the additional extra day in leap year, as public holidays excluded from the succession of weeks. New Year's Day and Leap Day (the latter inserted between June and July) being thus ignored, it is arranged that each quarter shall begin on Sunday, and the months in each quarter consist of 30, 30, and 31 days respectively. It will be seen that by this arrangement Christmas Day would always be an alleged Sunday, and that all anniversaries would be celebrated on the same day of the alleged week every year, except those that occurred on the extra days, which would be excluded from the week altogether. In view of the tremendous opposition this totally unnecessary change would be sure to arouse on the part of theologians and Sabbatarians of nearly every creed, it is curious that the author seems unable to conceive of any possible objection to what he evidently considers an enormous boon to the human race. He proposes that this scheme be adopted from 1910 January to give people a little time to get used to the idea beforehand. The objection that certain football clubs might urge against the keeping of Christmas on Sunday can be plausibly met by the rejoinder that there would be practically two Saturdays at the end of that week. The keeping of birthdays on the "wrong" day, now sanctioned in the case of people born on February 29, would obviate all but sentimental objections on that score. But we have not yet reached the stolid state of ignoring sentiment, and we sincerely hope that we never shall. Until then there appears no reasonable probability of Mr. Philip's proposal being adopted.

The Control of a Scourge, or How Cancer is Curable, by Charles P. Childe, F.R.C.S. (London: Methuen, 1907; 7s. 6d. net).—There are few families that have not had the misfortune to lose one or more of their members from cancer in some form. If this fact be remembered, it will not be difficult to understand Mr. Childe's object in writing this book. He hopes to try to interest his countrymen in what is a scourge, and to place before them certain recognised facts relating thereto. Mr. Childe considers that whatever the investigations now undertaken by the Imperial Cancer Research Fund bring to light, yet the diminution of cancer as a death-dealing disease must always largely depend on its early recognition. Whether posterity is to find a cure by the exhibition of a drug, or the injection of an antitoxin, none can say, but this is certain, whatever the treatment, much will depend on an early diagnosis. In these times the immediate application of the surgeon's knife when malignant disease has made but a beginning, is the only chance of saving life. Medical men of experience the world over can bear out this statement, for cases of undeniable cancer have been cured by early operation, while those left to Nature, drugs, and the Christian Scientist invariably end fatally. Mr. Childe is of opinion that the general public requires such enlightenment in personal observation as will help it to recognise the earliest signs and symptoms of this fell malady, and so seek advice, leading to a speedy removal by operation of the offending growth. He correctly points out that in its very early stages the disease is localised and circumscribed, and at this time can be removed without the likelihood of recurrence. Procrastination means that a local disease becomes constitutional; the surgeon's knife relieves, but does not cure. The employment of surgery late in the disease results in the loss of adherents to its efficacy as a curative agent. Mr. Childe, in these pages, has sown the seed of self-help which, if it has not fallen on barren ground, may prove a dominant factor in the fight against this disease. It is a Herculean task for one man to perform—to try to educate his fellow creatures to the necessity of knowing themselves, and to put aside that secretive element, which is, after all, very human, and which seems to be a more particular characteristic of this disease. This work should advance the cause which Mr. Childe has at heart, the more so if the active support and co-operation be secured of those responsible for the education and moral training of the nation's youth and womanhood. Medical men will second the efforts to inculcate the lessons that are so strenuously advocated by the author.

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